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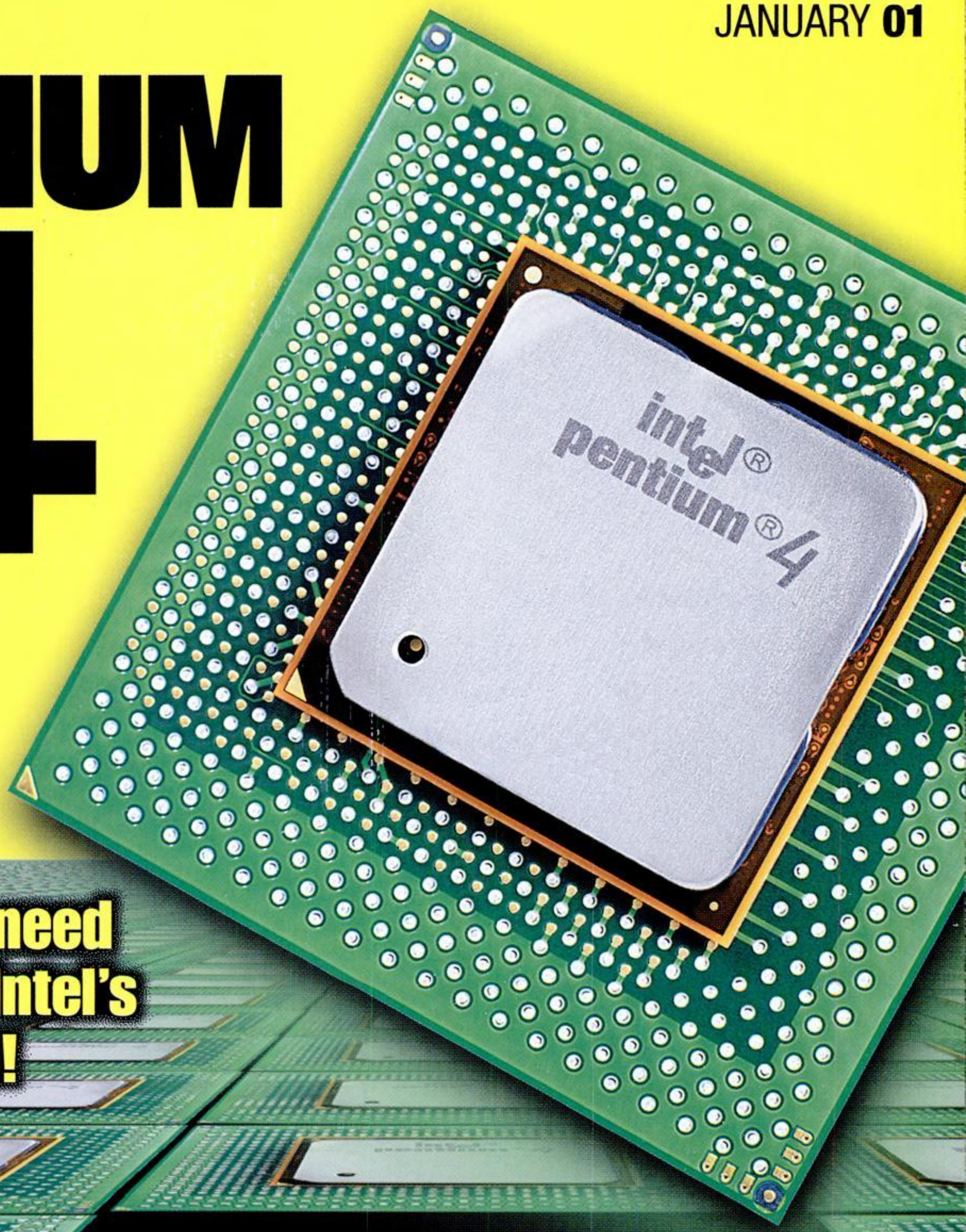

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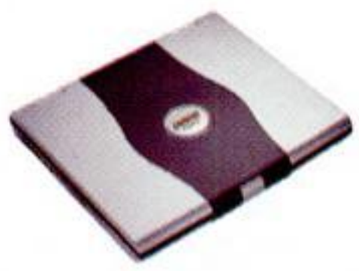

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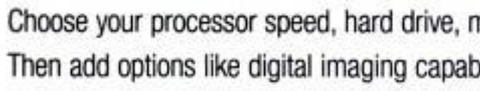

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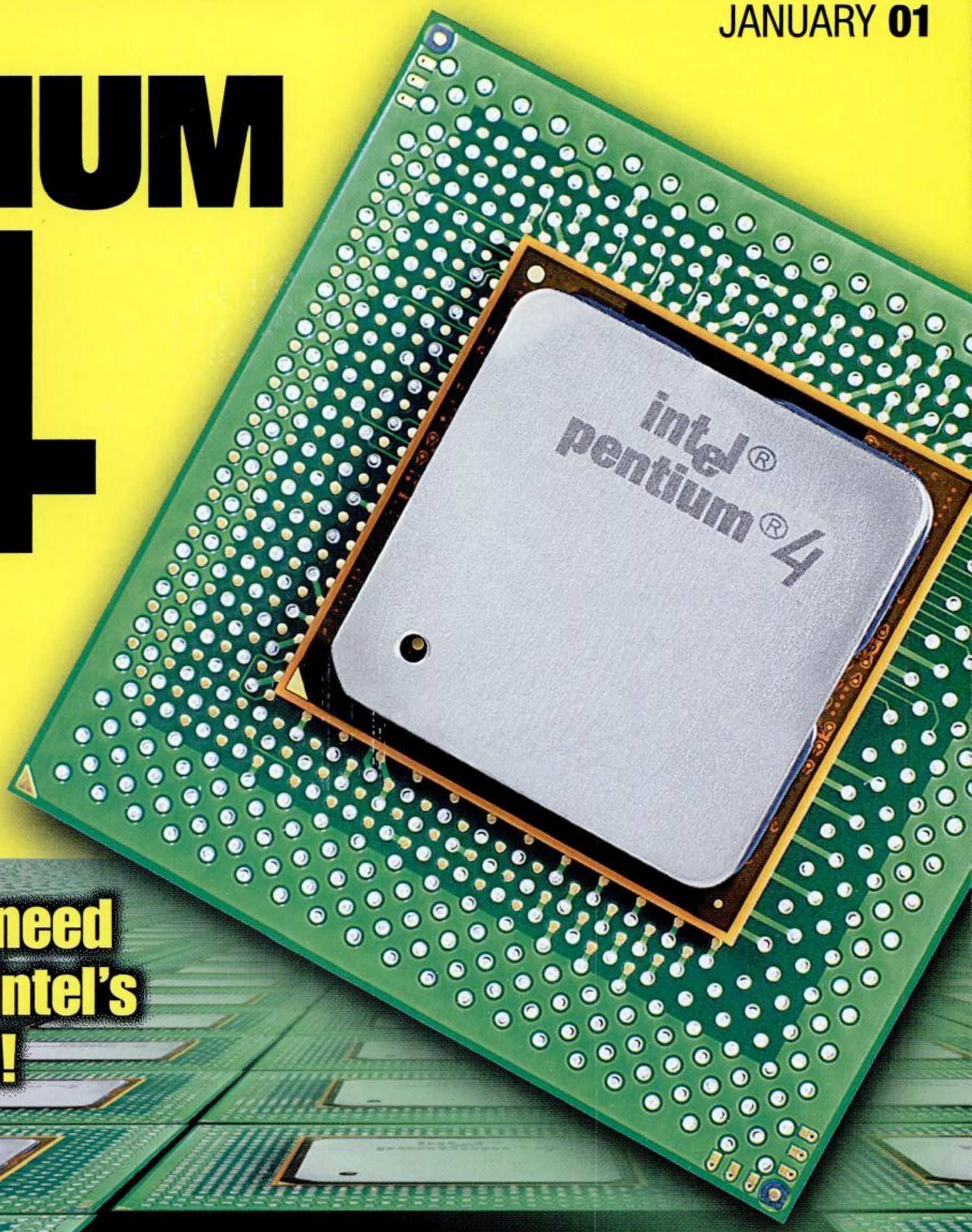

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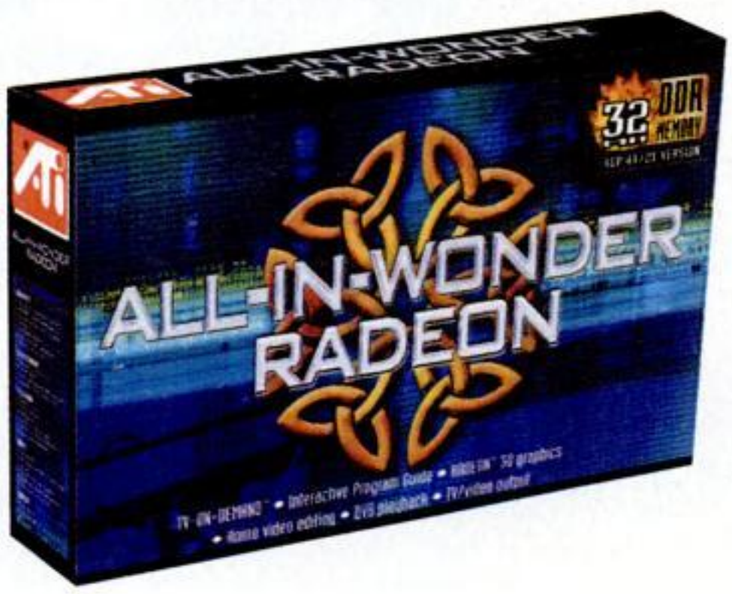

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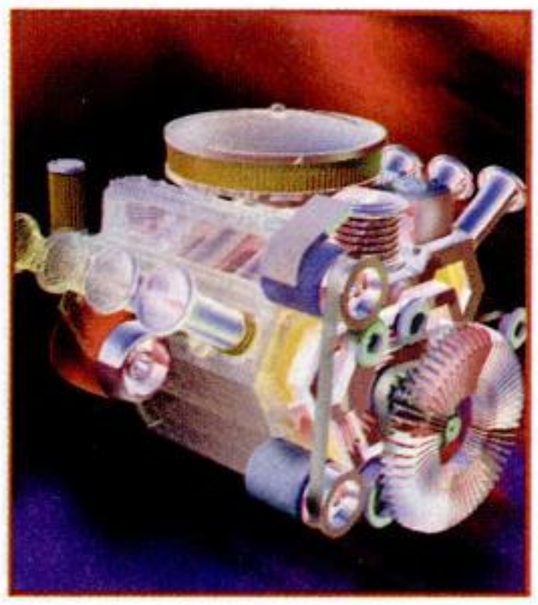

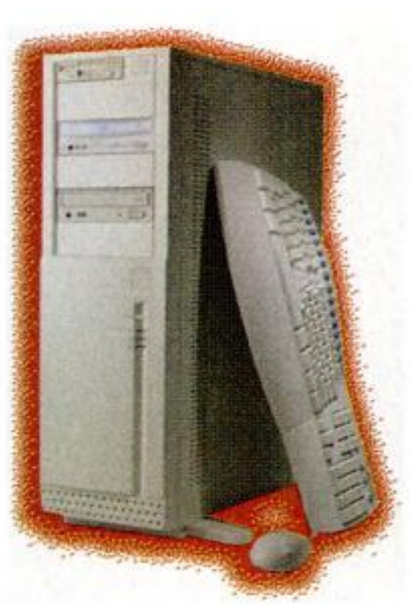

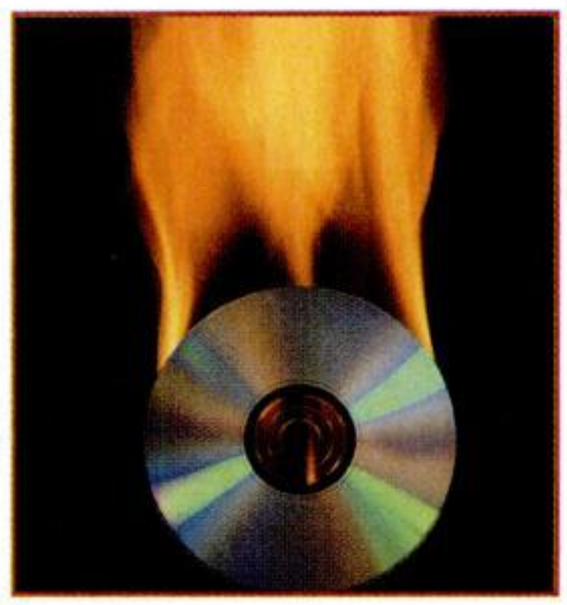

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COVER PHOTOGRAPHY BY AARON LAUER

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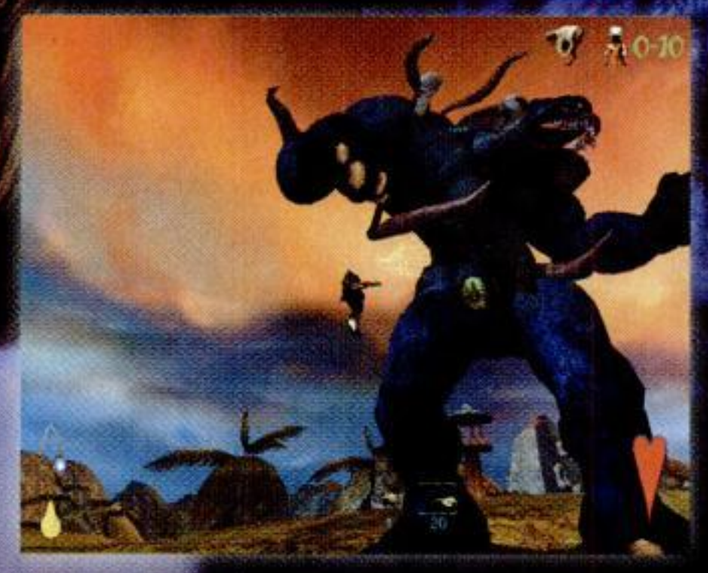

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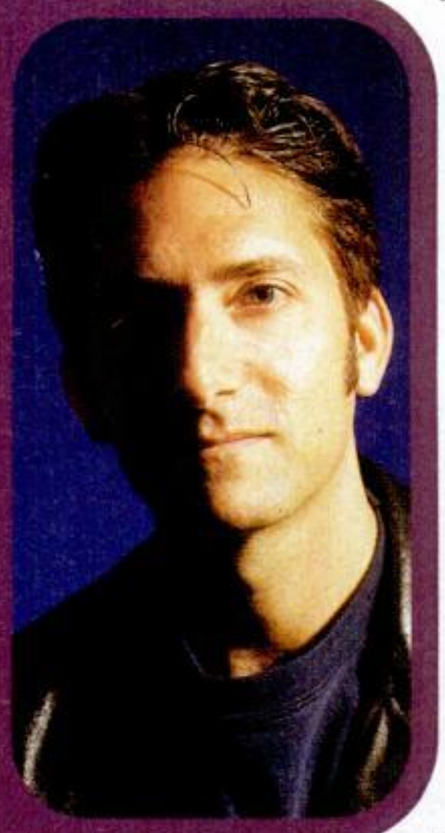

Does the term "nondisclosure agreement" mean anything to you? It's a term that technology journalists encounter with increasing frequency. The scenario plays out something like this: A manufacturer invites a journalist to a sit-down meeting in order to share some yet-to-be-released product information. The journalist gets nice and comfy, and right before the meeting begins, the manufacturer's PR flack shoves a nondisclosure agreement in the journalist's face.

An "NDA" is essentially a legal contract that prohibits the journalist from publishing specific product information before a particular date. When faced with an NDA, the journalist has two recourses: Refuse to sign, thus calling an end to the meeting and leaving without the preview information, or sign the agreement because receiving information with strings attached is better than receiving no information at all.

The problem with NDAs is that they oppose the journalist's natural instinct to share information with the public as quickly as possible—this leads to ethical dilemmas. Case in point: A few months ago, we received a number of Pentium 4 machines from system vendors. We were encouraged to test the systems, but the NDAs we signed prevented us from publishing benchmark results until sometime in October. Then, a few weeks after we received the systems, Intel pushed back its P4 release date, and the system OEMs reacted by pushing back their benchmark embargoes until late November as well. Thus stewed *Maximum PC*. We had the benchmarks, and we wanted to share them with the world, but a ridiculous legal formality denied us from spreading the word.

NDAs were originally created to protect design patents. An inventor would ask a potential partner to sign an NDA before sharing information on the patent's utility. In other words, the NDA was a "business-to-business" construct. But now NDAs are used to exert control over the journalist's reporting process—spin doctoring, by any other name. Technology vendors like to have ultimate control over product roll-outs: when advertisements appear in magazines, when products appear in stores, and when independently conducted benchmark results hit consumers' eyes.

Well, enough might finally be enough. We were ready to publish our Pentium 4 test results in last month's issue, but held back because we didn't want to betray NDAs. The benchmarks appear this month, but you, the reader, pay the price. You buy our magazine, in part, to read the earliest breaking technology information. But we didn't give you the P4 benchmarks as quickly as we could have. So now is the time to poll your opinions regarding NDAs. Do you think we should sign fewer NDAs? Do you think we should reject all NDAs entirely? Let us know in an e-mail to editor@maximumpc.com.

NDAs are used to exert control over the journalist's reporting process.

In most cases, the information garnered from an NDAed meeting is downright uninteresting—as if anyone really gives a damn that Allied Mousing Products will be releasing cashmere mouse cozies six months before the competition. But sometimes NDAed information can be much more compelling. We currently sign NDAs to stay competitive with all the other news organizations that sign NDAs, but it's entirely possible that if we rejected the contracts we could still gather the information you desire with good, old-fashioned sleuthing—and then publish the information ASAP without fear of reprisal. Tell us what you think. The NDA issue is far from closed.

—Jon Phillips

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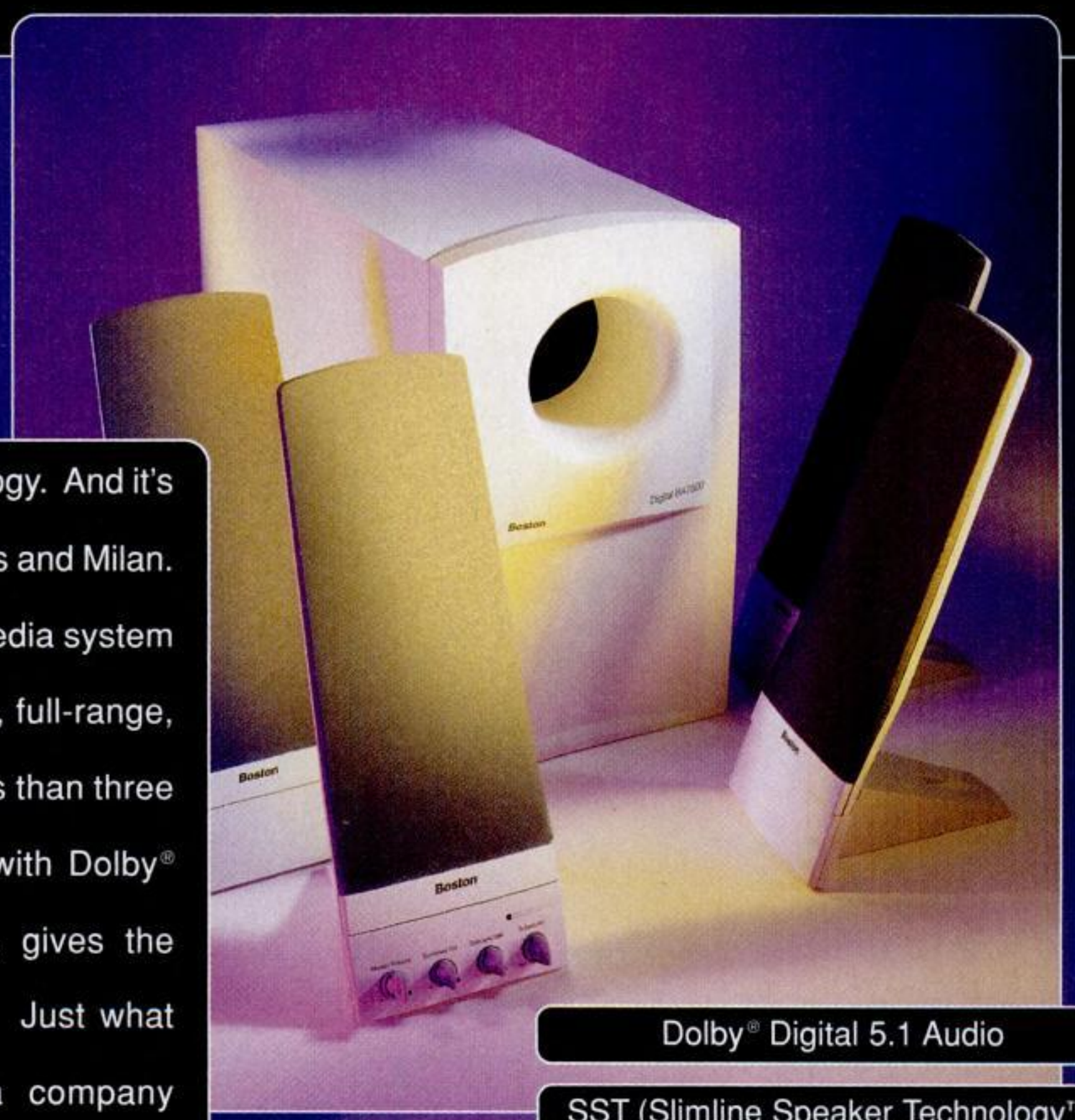
HOME CAR MULTIMEDIA CUSTOM

ITS FATHER WAS A $5,000 HOME THEATER SPEAKER. ITS MOTHER WAS A SUPERMODEL.



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Unleash the PC Avengers!

You folks love PCs. You folks even appreciate Macs—as one might extrapolate from all the positive letters we received regarding our Power Mac G4 SMP coverage. But what you folks *don't like* are Mac users who blindly defend stupid Apple design decisions and who can't take a joke.

Much of our CommPort e-mail of late refuted the letter from Lani (December 00), who bashed us for taking a few humorous pokes at the aesthetically pleasing but functionally suspect G4 Cube. In a nutshell, Lani told us to keep to ourselves, to stick to PC coverage because Macs are none of our business. You responded to her letter with careful, sober reasoning, leaving out any hints of "PC activism" entirely. Well done, readers! You didn't take Lani's bait, and now *all* PC users appear better for it. (And, boy, you should have seen all the mean words we removed from Lani's letter before it was published!)

The Boob Cube

I found myself put off by Lani's CommPort comments regarding your portrayal of the G4 Cube. First of all, the statement "Mac people are quite happy with the product" is a bit broad. I've read many a posting on the *MacAddict* web forums regarding the Cube: Where is its place in Apple's marketing strategy? Why does it cost so much compared to a regular G4? What purpose does it fill for a professional or home user? There are plenty of Mac users out there who range from baffled to downright irate that Apple assembled the Cube in the first place. Sure, it's small and runs cool, but it costs as much as a regular G4, with far less expandability.

I also disagree with the assertion that your readers "couldn't care less about articles regarding Mac products." I'm passionate about all computer technology, not just PCs, and I subscribe to both *Maximum PC* and *MacAddict*. It's refreshing to see a review of a Mac product from a predominately PC-user-based magazine.

—Gordon Delp

I'm passionate about all computer technology, not just PCs, and I subscribe to both *Maximum PC* and *MacAddict*.

Please Define "Perfection"

What hardware, software, setup, benchmarks, etc. does it take to get a Kick Ass/Perfect 10 verdict? Also, I would like to know what *all* of your highest benchmarks are—this will give readers a standard to destroy with their own systems

—Alexander Angel

Reviews Editor Josh Norem replies: For a product to garner a Kick Ass Award, it must receive at least a 9 verdict. For a product to receive a Perfect 10 verdict, it must (a) be the best product in its category at the time of the review and (b) represent an unprecedented level of performance and innovation. No hardware or software is flawless, mind you—we always want better performance and more features for less money—but a Perfect 10 represents the transition from "kick-ass" to "this product kicked us in the ass, knocked us off our feet, and rolled us down the staircase." And for extremely complex products that have a host of sub-systems (such as notebooks and desktops), a 10 verdict might also be awarded to the product that makes the fewest compromises. And, yes, it's a very subjective judgement call. This month, the Voodoo system on page 76 earned a 10, in part for its unprecedented wiring scheme.

As for the highest benchmark scores we've seen, you can refer to the "Rank" column in our new benchmark chart. The chart is explained in detail at www.maximumpc.com/benchmarking/index.html.

But since you asked, as of press time, the highest scores we've seen are as follows: *SYSmark 2000*: 206; *HD Tach*: 40MB/sec (average read speed); *CD Tach*: 61.6x (drive rating); *Quake III*: 121fps; Direct 3D: 99.7fps; Adobe *Photoshop*: 105 seconds.

It's important to note that the *CD Tach* score was achieved testing a stand-alone component, namely the Kenwood TrueX 72x. It's unlikely we'll ever see a *CD Tach* score like this in any system review, because all system vendors have eschewed dedicated CD-ROM drives for CD-RW and DVD-ROM drives.

Please Define "Reviewed"

I've always valued your reviews, but after looking at the December 2000 Gear of the Year issue, I'm beginning to wonder. How can you say, "We've tested everything," and then proclaim the TDK VeloCD to be the CD-RW Drive of the Year when it was "not yet reviewed"? And if the VeloCD beat out the Plextor model, why is the Plextor pictured in the photo of your exuberant staff?

—D. Sprunger

Editor-in-chief Jon Phillips replies: When a product receives a "not yet reviewed" notation in our annual Gear of the Year feature, it means the product hasn't yet received an official review verdict in our monthly reviews section. But rest assured, all Gear of the Year winners were submitted to brutal bench-

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marking and test-driving before receiving their honors.

The products in our staff photo are not meant to represent the winners. The staff photo was shot about a week before we made our final award decisions, so our art directors had to load the shopping cart with any box or product they could find.

Are You Guys RAIDtarded?

What is it with you guys and RAID? You wrote, "SCSI RAID = Pain in the ass" ("I'd Sell My Soul for a Perfect 10," November 00). You obviously haven't been working with RAID all that much to make a statement like that. Why aren't you using RAID controllers that are proven to work, such as Adaptec RAID controllers. The entry-level workstation SCSI RAID 2100S controller with 32MB cache (expandable to 128MB) kicks ass! It supports just about every OS out there (including WinNT 4.0, Win2000, Win95/98, and Linux). If you must insist on IDE RAID, then check out the Adaptec Ultra DMA/66 RAID. No, I don't work for Adaptec, I've just used its products enough to know they work.

—Keith Schoolcraft

Senior Editor Gordon Mah Ung replies: Keith, we considered using the Adaptec RAID 2100S card in Dream Machine 2000, but our DeLorean was in the shop with a busted flux capacitor. Otherwise we would have sped up to 88mph and jumped into the future to buy the 2100S—which wasn't available until *after* the September Dream Machine issue hit the stands. However, we do have the Adaptec 3200S (the 2100S's big brother) in for review. I think if you had gone through the teeth-gnashing we experienced with the DPT controller, you'd feel ass pain too.

Blowing Hot Air?

Your article "Teaching Your System To Breathe" (Lab Notes, November 00) left me wondering. Although Plexiglas, smoke, and duct tape are fun to play with, I think a much better approach would have been to gauge temperature rather than smoke flow. You should re-do the experiment by installing temperature sensors on all the heat-generating components. Start with all your fans off, record the temperatures, and then start switching fans on, again recording temperature readings to determine the benefits of different cooling situations.

—Pete Ulrich

Senior Editor Gordon Mah Ung replies: What we really wanted to do with the "system breathing" article was illustrate just how important it is to have a good game plan with system fans, and how placing them haphazardly can be very inefficient. Since it's almost always cooler outside of a case than it is inside, one of the most important cooling issues is proper airflow. We considered using temperature probes, but decided to save them for an upcoming Lab Notes in which we determine which specific fans give you the best cooling throughout your case.

And a Processor in a Pear Tree...

'Twas five weeks before Christmas,
on page forty, what bliss!
A picture and wish list
of a goddess named Kris.
Ten out of ten,
Kick Ass! I do say!
I'll be her dishwasher
if that'd be okay!!
If so, here's my number
and my address.
If not, Merry Christmas
and Kristen, God bless!

—Timothy C. Steinert

Features Editor Kristen Salvatore replies: I simply don't possess Timothy's poetic stylings, so haiku will have to do:

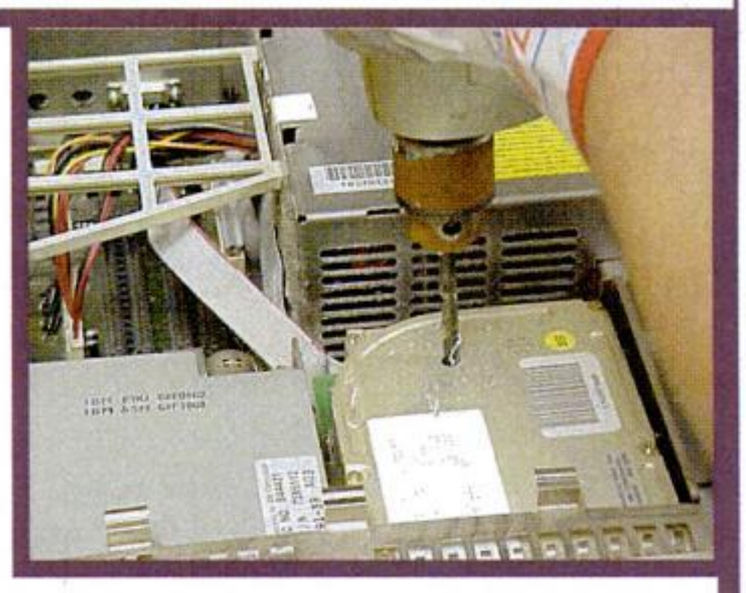
Tim, what poetry!
Your kind rhyming makes me blush—
And I don't blush much!

Dishwasher—that's great.
But what I must know is this:
Do you do windows?

Drills Are Fun!

We had 20 old computers to get rid of. Rather than spend days with a file shredder program, I got out my handy drill and went right through the hard drives. How safe is this, in terms of anyone getting the data later?

—Ben Eggenberger



Associate Tech Editor Scott Tarr replies: Ben, your method seems more than sufficient. You've made the drive platters practically useless for transferring data—because of the hole you drilled, the unit's drive heads simply won't be able to move across the platters in their usual fashion. What's more, the shrapnel from the platters will also stop the heads from acting in a manner consistent with normal use. It would be virtually impossible for the casual user to retrieve any data from your disks.

However, there are some alternatives. You could also have rewritten the sectors of the drive. Word has it that the Department of Justice considers a drive rewritten this way three times to be "clean" of sensitive data. You could also have had the drive degaussed. This process uses a magnetic field to erase all data.

Too Much Murder Simulation Leads to Bad Grades

I'm writing concerning your comments in "Government Frags Gamemakers" (Spin Cycle, November 00). In the Our Take column, you state, "Parenting should be left to parents, not government regulators." It's such an easy comment to make. It sounds good, it's politically correct, and it absolves the industry of any and all accountability in one fell swoop. And, as the parent of four children, I'm tired of hearing it. I personally think it's one of the biggest cop-outs perpetrated by the entertainment industry today. Do I think parents are solely responsible for their children? Absolutely. Do I want more government intervention? Not at all. But do you realize how hard it is to raise children in today's society? Sexual and violent imagery is everywhere and is quickly encroaching on areas previously

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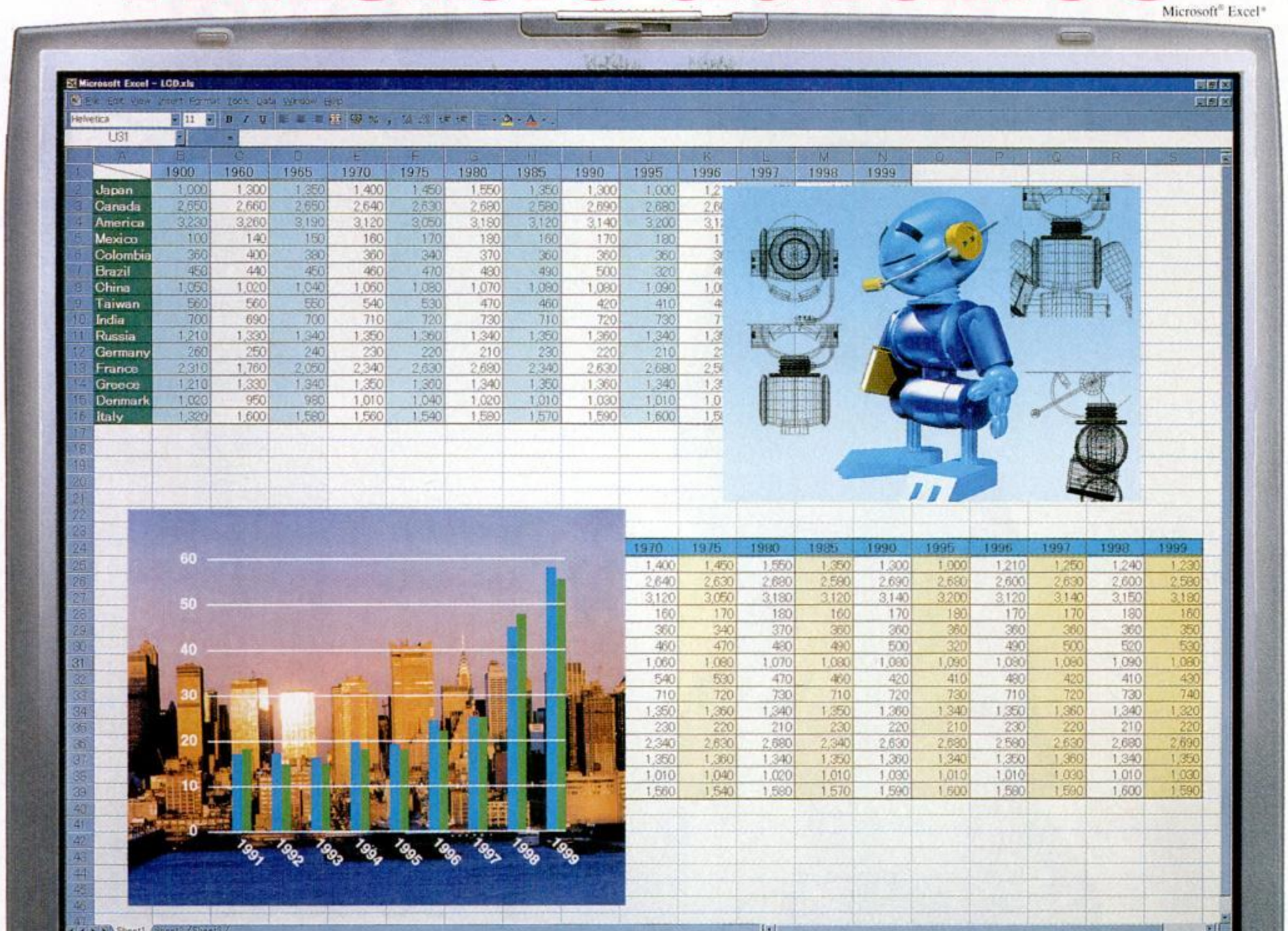
A visible advance

Microsoft® Excel*



The 15" UXGA TFT LCD

Actual image generated by Toshiba's 15" UXGA TFT LCD.

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•Dimensions (W x H x D): 315.8mm x 241.5mm x 7.1mm (max) •Weight: 670g

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thought safe for children. It frustrates me that the entertainment industry wants to leave "parenting to the parents," but then tries so hard to circumvent their authority.

—Jerry Foster

Editor-in-chief Jon Phillips replies: These are all good points, Jerry. And I have to admit, the *Maximum PC* staff might lack perspective: At the moment, none of us has children (in fact, some might argue we're still children ourselves). I won't speak for the rest of the staff, but I personally believe that game distributors have a responsibility to label their content honestly and carefully, and parents, in turn, have a responsibility to monitor every single game a child plays—assuming the parent is *that* concerned about what his child is doing with his spare time. This commitment requires an enormous amount of time and energy, but that's the parent's lot in life—and precisely why many people delay having kids, or choose not to have any kids at all.

RAID Upkeeping

Great article on RAID [October 2000]. I have some questions regarding disk maintenance: For continued optimum performance, do RAID drives require periodic defragmentation like stand-alone hard drives do? If so, any software recommendations? Also, does your recommendation vary depending on the operating software (for example, Windows NT versus 9x)?

—Jim Clawson

Reviews Editor Josh Norem responds: For all intents and purposes, a striped RAID array is nothing more than a single, logical drive. Therefore, it requires the same level of maintenance as a single drive, including regular defragmentation. To accomplish this task, most Windows 98 users prefer to use Disk Defragmenter, which is included with the OS. More selective users opt for *Speedisk* from Symantec, which is part of *Norton Utilities*. For NT/2000 users, Executive Software's *Diskkeeper* is the defragger of choice when dealing with NTFS partitions. Windows 2000 includes a "lite" version of this application, but NT users are S.O.L, and will have to purchase it on their own.

A Humble Request

I would like to talk about Dream Machine 2000. I think it's awesome and have no complaints or any smart remarks to make about it. I hope you still have it up and running, because that computer is like a god to me and my associates. I think your magazine is great for any computer beginner and even helps and guides a computer vet like myself. By being a valued customer of your magazine I ask one favor in return—that you publish this letter in the next issue of *Maximum PC*.

—Justin J. Tavella

Reviews Editor Josh Norem responds: Justin, there are times when the entire staff of *Maximum PC* works evenings and weekends to provide readers with the best PC information on earth. It's a labor of love, but we do it all for you. It's readers like you who reaffirm our belief in the magazine's mission and push us to work even harder. About the Dream Machine: It's ironic we received your inquiry this month because we've included an "update" at the beginning of the Reviews section. Turn to page 74 to find out how your old pal is doing.

Stop the Violence!

The juvenile display of machinery à la bullet holes ("Hardware Assassin," December 2000) just doesn't do justice to your mag. Hey, you wanta shoot your shit fulla holes, OK, but do it on your own time, and don't mess up my magazine with this nonsense.

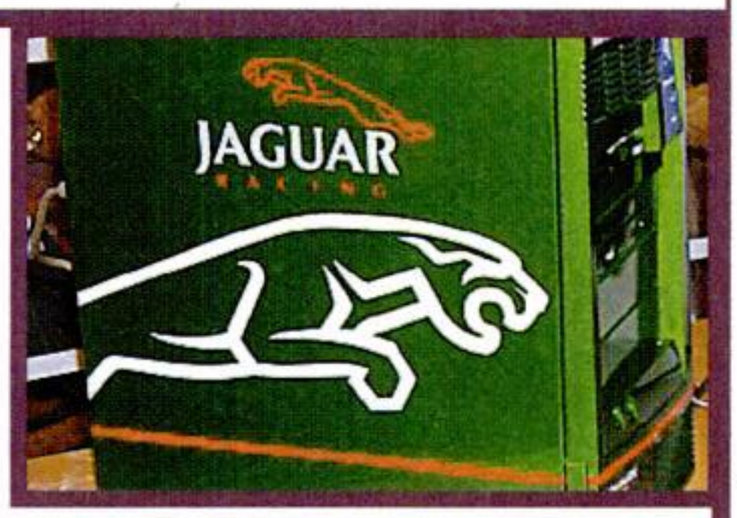
—Marty Canning

Editor-in-chief Jon Phillips replies: Marty's letter evoked a few memories. For one, I can remember the reader who hated his new *Maximum PC* subscription so much, he actually sent back his first issue of the magazine—riddled with bullet holes (.22 caliber by Gordon's best estimation). I also remember the handful of readers who received incomplete copies of the September 00 issue—due to a bindery error, their copies actually lacked entire sections of the magazine. Too bad Marty's issue wasn't missing the precise pages he founded nonsensical.

But in all seriousness, we knew we were taking some chances with the "Hardware Assassin" photo essay. It contained no information that could directly benefit the reader's computing experience, and as a piece of humor, it was a risky endeavor—one person's joke is another person's waste of time. Nonetheless, *Maximum PC* has always tried to project a little levity, and we don't intend to stop now.

Painting Your PC

About painting your PC Entertainment Center (November 2000): Here's what the award-winning car modelers do when they paint their car models: 1) Remove any logos with brake fluid. Use a cotton swab to apply the solvent. 2) Wash the plastic with liquid dish detergent. Rinse off completely and allow the part to air dry. 3) Prime the plastic parts with a plastic-compatible auto body primer. Omit this step and you can throw your plastic parts in the garbage. 4) Paint the thing with auto body paint. You can get all kinds of super metal flake colors at any place that sells car parts. The best way to apply the paint is with an internal-mix, single-action airbrush. Spray the auto body paint into a jar, thin it if needed, then pour it into the airbrush bottle. The airbrush will give you loads more control than a spray can. Put on as many coats as you like.



When it's done, spray on a clear coat and finish up with some very fine clear car wax.

—Bill Williams

Editor-in-chief Jon Phillips replies: Excellent advice, Bill. And, in case any readers are wondering how cool a painted case can look, check out this photo of an HP box tricked out by Jaguar's racing team. This machine uses the same custom metallic paint that's applied to Jaguar's Formula One cars. Awesome!

CUT COPY PASTE

▶ In our October review of *Icewind Dale*, we incorrectly stated the game lacks a Quicksave feature. In fact, this feature is present, and can be activated by pressing "Q." In our November cover story on building the ultimate PC entertainment center, we listed the wrong model name for our case of choice. The correct name is Coolermaster ATC-200-MX. ✹

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Next-Gen Windows

We Take the Merger of WinME and Win2000 for an Early Test-Drive

Since the first version of Windows NT was released, Microsoft has espoused a "two OSes for two uses" policy. Windows 95-based OSes are recommended for home users, and Windows NT-based OSes are recommended for corporations and workstation folk. This policy will change when the next version of Windows is released sometime in the second half of 2001. Currently codenamed Whistler, the OS is based on the NT core and should provide the stability and performance that corporate users demand in business apps, along with the blazing-fast performance that home users require in 3D games.

ATI RAGE MOBILITY-P AGP (English) Properties
General
Driver
Resources
ATI RAGE MOBILITY-P AGP (English)
Driver Provider: ATI
Driver Date: 3/24/2000
Driver Version: 5.0.2195.4015
Digital Signer: Microsoft Windows Hardware Compatibility Pub
Driver Details...
To view details about the driver files.
Update Driver...
To update the driver for this device.
Roll Back Driver
If the device fails after updating the driver, roll back to the previously installed driver.
Uninstall
To uninstall the driver (Advanced).

An enhancement to the System Restore tool from WinME allows users to restore previous versions of individual drivers, instead of having to restore the entire system.

Here's our take on Whistler Beta 1. It's the first release outside of the Microsoft campus and is intended for hardware and software compatibility testing.

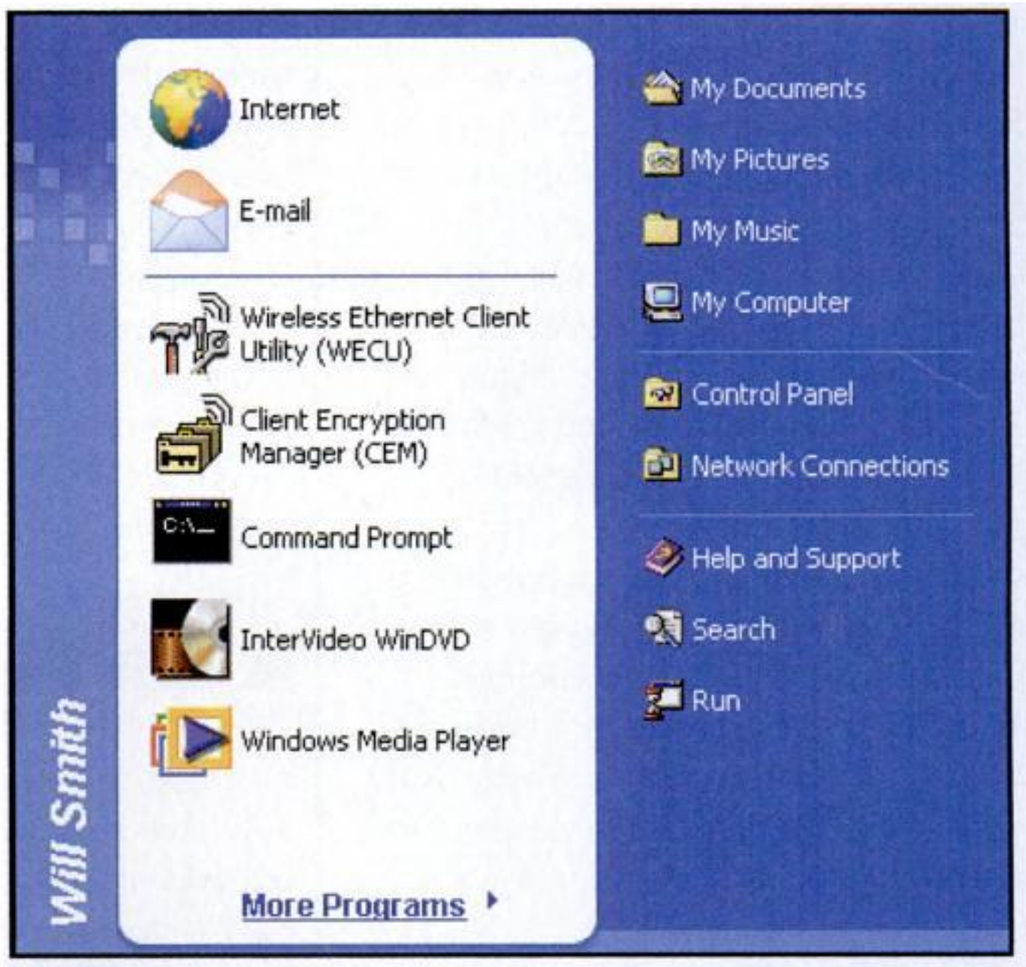
Behind the Scenes

Though Whistler and Windows 2000 share a Windows NT heritage and, thus, many of the same features and underpinnings, Whistler does demonstrate some welcome improvements. High on the list is a better implementation of the Hardware Application Layer (HAL); many of the problems plaguing Windows 2000's execution of HAL and DirectX have been solved in Whistler, netting big 3D performance gains.

We also appreciate Whistler's application compatibility database, which stores information that allows Windows 95 and NT applications to run in the new OS. Because the stored data allows Whistler to mimic the Win95 and NT4 environment settings, even incompatible applications will run.

How many times have you installed a new driver only to find that the "new and improved" software has made your system unstable? Whistler's driver rollback feature ensures you can always go back to older, more reliable driver versions—they're stored in a database similar to the System Restore tool. Because Whistler supports various driver installs on the fly, you may not even need to reboot in order to escape from driver hell. Additionally, Whistler should support any device with Windows 2000 drivers, and the OS will finally take advantage of the "driver updates" section of the Windows Update web site. In fact, you can even connect to the site while you're setting up the OS, so you won't spend three hours upgrading drivers.

If you're the go-to person in your house when it comes to tech support, Whistler should make your life considerably easier. The Remote Control program allows you to view and control another Whistler user's computer (once he or



The biggest change in Whistler is the dynamic Start Menu. It is finally the actual start point for all functions of your computer.

SPIN CYCLE

This month's top stories broken down ►

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
Intel Details 0.13 Plans	Intel says it's ready to begin manufacturing CPUs using a new 0.13-micron copper process technology.	The 0.13 process will allow Intel to hit multi-gigahertz speeds, pack more than 100 million transistors onto a die, and make procs that consume less power.	"This reaffirms our belief in Moore's Law," Intel says.	Intel badly needs this process to fight off AMD's assault of high-speed Thunderbirds.
Rambus Cruises On	Didja know Rambus holds SDRAM patents? It does, and now Samsung will pay for them in order to continue its lucrative SDRAM production.	Rambus now has four of the world's memory makers by the 'nads. No one wants to cease production due to an intellectual property dispute.	Rambus: "Our objective is to produce innovations that will benefit the semiconductor and systems industries and, by licensing these innovations, to generate a return on investment..."	If RDRAM takes a nosedive, Rambus shareholders will be able to thank corporate lawyers for a revenue stream.

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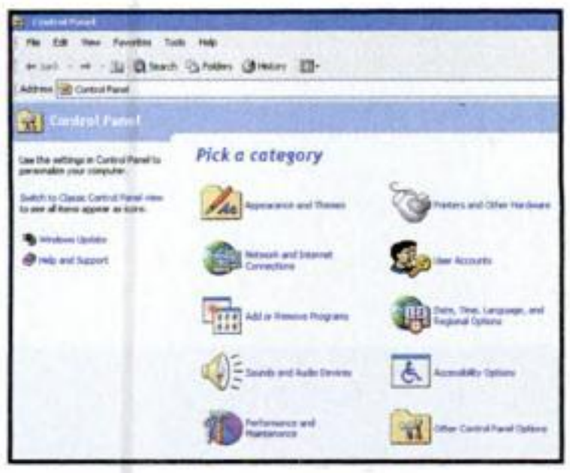


The Control Panel received a makeover in Whistler Beta 1. Icons are now grouped by functionality, rather than by older schemes that don't make sense anymore.

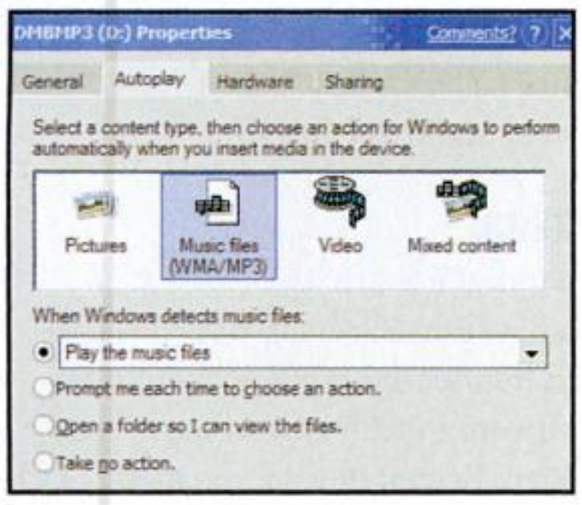
she has requested your help via an e-mail message), so instead of explaining to your Aunt Martha how to get to the Device Manager, you can just take over her computer and do it yourself.

UI Improvements

Whistler's most striking changes can be found in the Start Menu. The old pop-up menu that arrived with Windows 95 has been replaced by a much more intuitive menu. It's dynamic in that it changes to reflect your most frequently used applications. And it's even customized with your computer's name.

The now-standard sprawl of Desktop icons have also found their way into the Start Menu. Gone from the Desktop are My Computer, My Network Places, and My Documents (the same goes for the dreaded Online Services folder), making the Start Menu your one-stop shop for all the info on your computer. We applaud the sentiment behind this decision, though we'd like to see a default link in the Quick Links area to either Windows Explorer or to the computer's hard drive and DVD drive. As it stands, navigating My Computer requires multiple clicks, which is bothersome.

The Taskbar and Systray have also received some helpful cosmetic changes. Both have been tweaked to reduce clutter on the Taskbar, which now groups multiple windows of the same application under a single icon on the bar. The Systray also now monitors the icons that hang out near the clock and hides those that don't frequently change or aren't used, giving you more useable taskbar space.


DMBMP3 (D:) Properties
Comments?
General
Autoplay
Hardware
Sharing
Select a content type, then choose an action for Windows to perform automatically when you insert media in the device.
Pictures
Music files (WMA/MP3)
Video
Mixed content
When Windows detects music files:
Play the music files
Prompt me each time to choose an action.
Open a folder so I can view the files.
Take no action.

Autoplay has been expanded to intelligently perform different functions, based on the type and content of the media inserted.

We liked Whistler's ClearType font support, which greatly improves font readability on LCDs by tripling the horizontal resolution. Tab completion in the shell—a feature that *nix users have grooved on for a long time—also made the cut, and we enjoyed some of the new multimedia Autoplay features. Whenever you insert media (CD, removable drives, or even Compact Flash) containing video, pictures, or digital audio, the OS automatically launches the app on your computer that's associated with that type of file. Very clever.

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Printing and faxing
Personalizing your computer
Hardware
Performance and Maintenance
Networking
Accessibility
Mobile users
Security and administration
Fixing a problem
Multimedia
Starting Applications in Compatibility Mode
Use this page to start and test applications in Windows 95 or Windows NT 4.0 compatibility modes.
Caution: Be careful when using compatibility mode to bypass version warnings in setup and installation programs. Some applications are designed for a specific operating system and intentionally prohibit use on future versions. Those are most often system tools which run at a very low level and have the potential to cause serious problems if installed.

Compatibility mode allows applications to run in an environment that mimics either Windows 95 or Windows NT 4.

New and Improved—But Bigger Than Ever

For home users—at least those who didn't make the switch to Windows 2000—Whistler offers the first real changes to the Windows operating system since Win95 was released five and a half years ago. It's much more robust than its Win9x-based predecessors, and, surprisingly, we suffered just one crash during testing.

The OS's main sticking point will likely be its steep system requirements. Windows NT-based OSes have always been more hardware intensive, and we don't expect Whistler to be any different. It's time to ditch the 200MHz Pentium, kids.

Considering how stable the OS seemed in our testing, we won't be surprised if Microsoft makes its second-half of 2001 release date. Two versions, Personal and Professional, will initially be available. The main difference is that the professional edition should include management utilities for IT administrators. At press time, neither the final name of the OS nor the pricing had been determined.

We previewed beta software, folks. Anything you read here could change. We'll keep you posted on further Whistler developments as beta testing progresses.

—Will Smith

to the pertinent details.

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
nVidia Goes Mobile	Finally, nVidia will extend its graphics line to target PC notebooks with the GeForce2Go chipset.	The GeForce2Go features hardware transform and lighting and 4x AGP with fast writes, and will use either 64-bit or 128-bit memory.	The slightly higher power consumption of the T&L-enabled chipset will be offset by the fact that CPUs won't have to work as hard, says nVidia.	The big loser here will be ATI, which controls most of the notebook graphics market.
Transmeta In and Out	Transmeta's power-sipping Crusoe will no longer be used in the notebooks of two major PC makers.	IBM says it no longer plans to offer a Crusoe-based notebook. Compaq is waffling on whether it will use the new CPU.	Analysts believe performance, design, and marketing problems could have led to delays. Others speculate that sweet deals from Intel scuttled plans.	Transmeta may have awakened the sleeping giant in Intel, which could offer low-power products based on its new 0.13-micron process next year.

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DirectX 8 Is Here!

More Than You Want to Know About Microsoft's Gaming Legacy

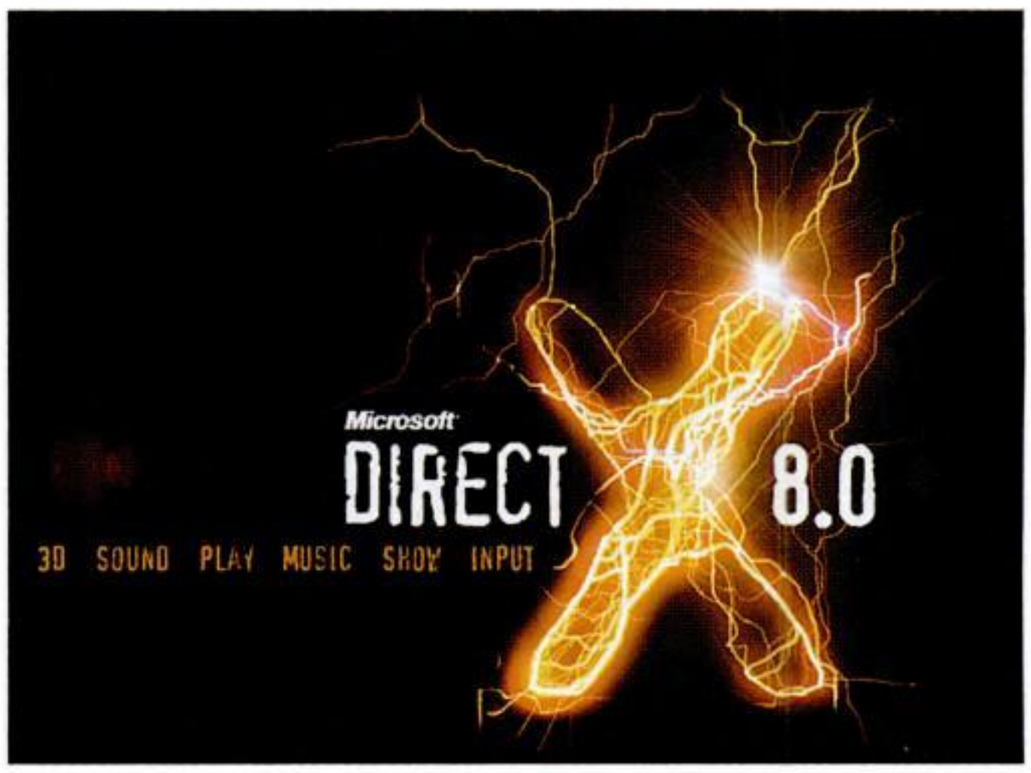
DirectX was originally heralded by Microsoft as the end-all, be-all for gaming on the Windows platform. You've heard a lot about DirectX, but do you know what it really consists of? You should, because DirectX 8 was released just a week before press time, and by now store shelves should be filled with DirectX 8 games.

In a nutshell, DirectX is a series of Application Programming Interfaces (APIs) that allows game developers to write software that accesses a computer's hardware at a very low level, bypassing the normal Windows APIs and the performance hit they impose on games. After initial skepticism on the part of the development community—why game in Windows with its massive overhead?—DirectX began to take off.

Prior to DirectX, developers wrote games for DOS and had to specifically code each title to support individual soundcards. The same was true of 3D accelerators. There were different versions of *Descent 2* for every 3D accelerator of the day—the S3 Virge, the ATI Rage II, the PowerVR, and the 3Dfx Voodoo. By ditching DOS and writing games to the DirectX spec, developers only had to create one version of the sound engine, one 3D renderer, and one network or modem interface.

When 3D acceleration was added to DirectX in DirectX 2, a controversy erupted. Developers chose sides and wrote their game code to either the OpenGL API (originally created by SGI for high-end workstation apps) or Microsoft's Direct3D. Opponents of Direct3D, such as John Carmack of id Software, said that DirectX 3 demanded a bass-ackwards approach to writing 3D code and didn't unearth the functionality that they expected from OpenGL. The battle between OpenGL and Direct3D was waged across the Internet and print media. Fortunately for gamers, with improved versions of Direct3D and more robust D3D and OpenGL drivers from hardware vendors, the furor died down.

The yearly releases of DirectX brought features such as 3D sound support, better support for networked games, and support for advanced 3D accelerator features such as hardware T&L. DirectX 8 is no different.



The Technology

Originally planned for inclusion in Windows ME, DirectX 8 didn't make the cut. In addition to routine but necessary updates to the familiar Direct3D and DirectSound APIs, DX8 now includes some interesting new technologies that should significantly enhance gameplay.

The enhancements to the graphics pipelines will allow us to inch ever closer to photo-realistic, realtime 3D graphics—if developers ever take advantage of them. DX8 includes support for programmable shaders and volumetric textures in hardware. Programmable shaders allow developers to use nifty shader effects however they like, which should make lighting effects look more natural. Volumetric textures give a polygon texture throughout its volume, so when you cut a tree in half, you see its rings.

The other major addition to DirectX 8 is the inclusion of DirectVoice and its supporting APIs. DirectVoice allows realtime voice communication between players in supported games.

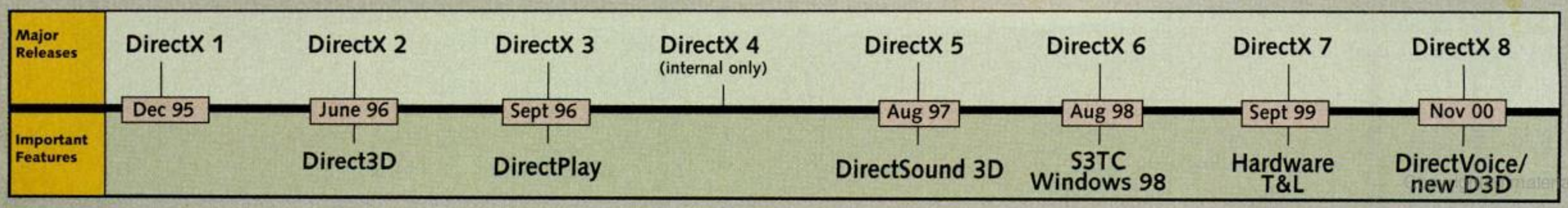
DirectX audio has also undergone serious changes. DirectSound and DirectMusic have been consolidated in one interface. This doesn't sound like a big change, but developers now have the ability to treat WAV files—read "sound effects"—as triggered music streams. This means that repeating environmental sounds, such as waterfalls, crickets chirping, or even character sounds, can be handled much more efficiently by the sound engine. This should allow developers to take advantage of more audio streams than ever before. Games that take advantage of this will have richer aural environments and will be able to utilize massive numbers of audio streams for effects.

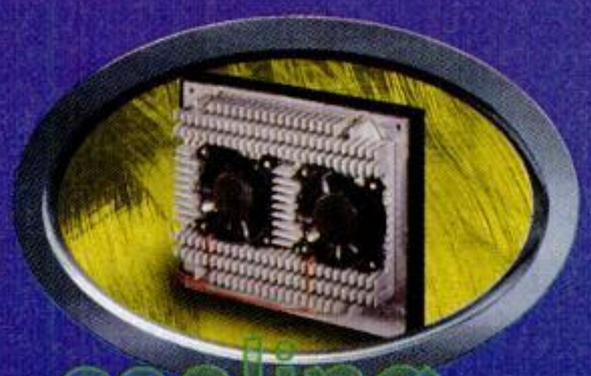
The Caveat

The expanded feature set of DirectX 8 should allow developers to fully leverage next-gen hardware—if game developers write software to take advantage of the new silicon. Even if developers *don't* embrace the new high-end graphics and sound features, expect to see DirectVoice support showing up in multiplayer games, such as *Team Fortress 2*, in due time. You should also be aware that DirectX 8 won't change anything about your existing games. In fact, early versions of new DirectX releases have seriously borked people's systems in the past. When you install a game that requires the new version of DirectX, it should be installed with the game, so you may even want to wait until you're forced to upgrade.

—Will Smith

The Evolution of DirectX Technology





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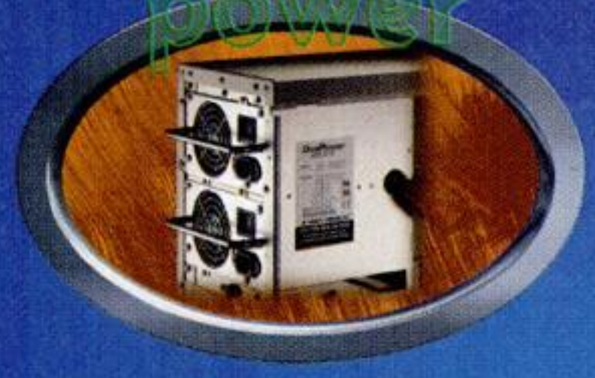

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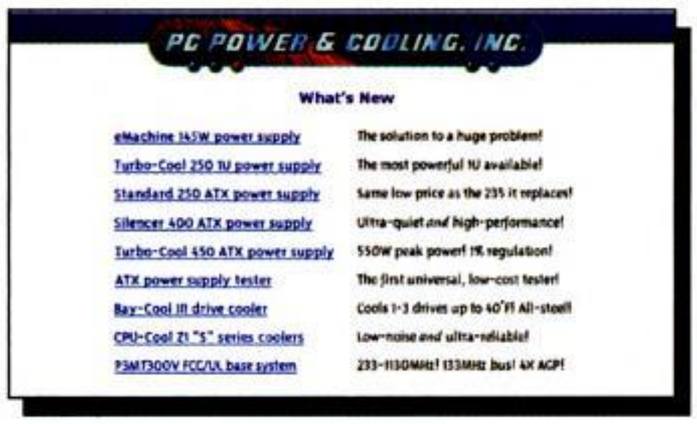
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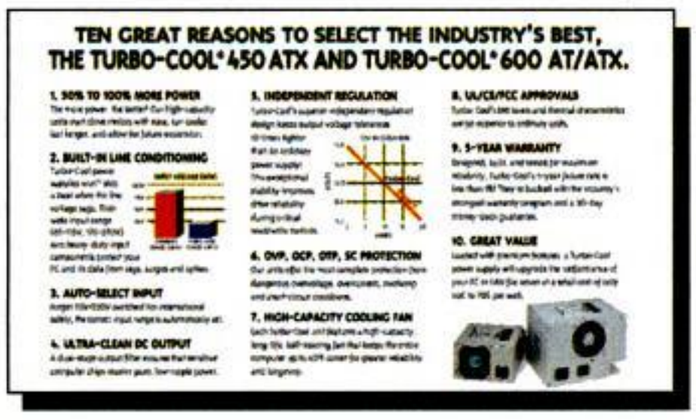
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▶ Maximum PC takes a bite out of bad service and gear

WATCHDOG

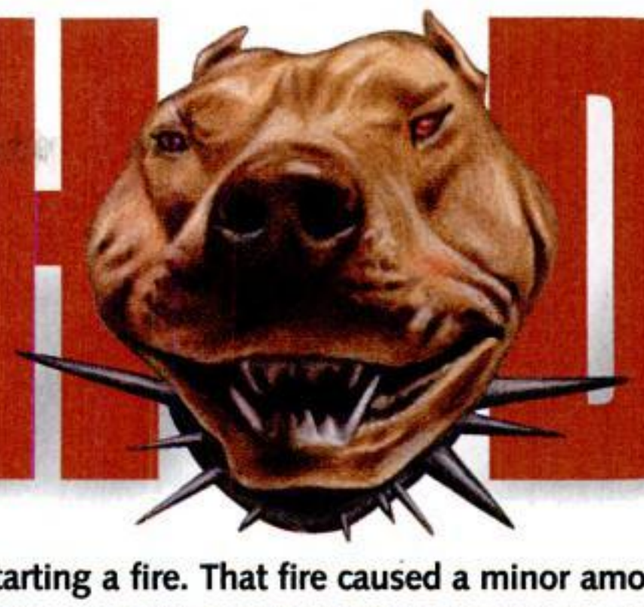


ILLUSTRATION BY SCOTT LAUMANN

Got a bone to pick with a vendor? Been spiked by a fly-by-night operation? Sic The Dog on them by writing **Watchdog @maximumpc.com**. The Dog promises to get to as many letters as possible, but only has four paws to work with.

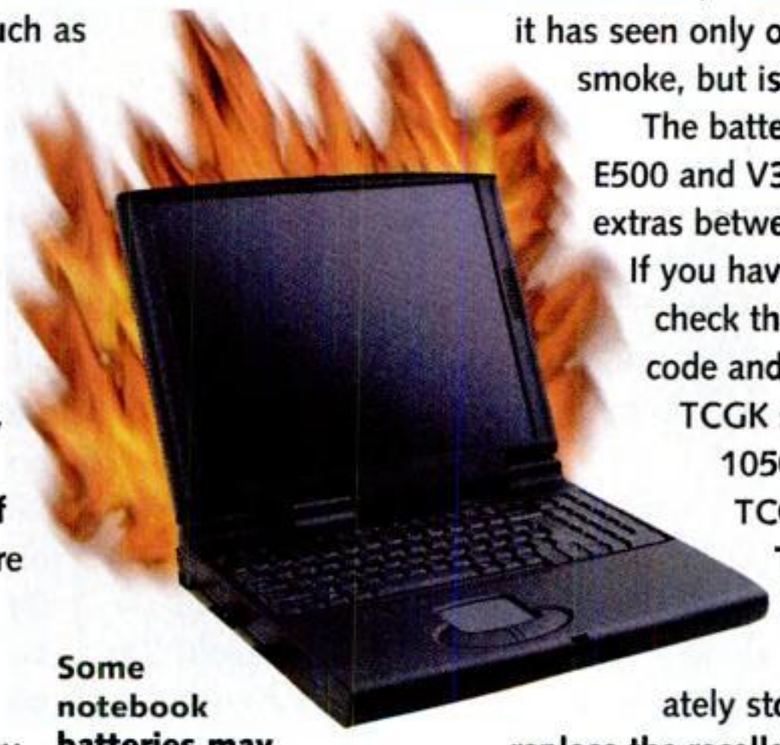
WEBTV SETTLES FEDERAL SUIT

Ever been disgusted by the claim that a WebTV set-top box can replace a PC? Well, such inane, sweeping statements should soon cease. WebTV Networks, Inc. has agreed to settle a suit that alleges the company violated the Federal Trade Act. The Federal Trade Commission accused WebTV of false advertising with statements such as "WebTV service offers complete and affordable Internet access."

The FTC used WebTV's own television ads to bolster its charge of false advertising. In one ad, for example, WebTV stated, "Now that WebTV came along, heck, who needs a computer? For almost a fraction of the cost, I can visit any city in the world, learn facts and even send e-mail. And best of all, I won't have to worry about software upgrades since WebTV handles that."

The FTC says that while WebTV might claim its product precludes the need for a PC, WebTV devices can't play most streaming media; they can't run Java apps such as chat room interfaces or online games; and, of course, they can't download or run software on the Internet. WebTV has agreed to stop misrepresenting WebTV devices and services and will publish a consumer education campaign to let people know the difference between WebTV and real PCs. Additionally, WebTV must now disclose that toll calls may be associated with the service, as well as reimburse people who cancelled the service due to long-distance bills.

A good grandson or granddaughter would determine whether WebTV owes his or her grandparents money. For the full deets, visit **www.ftc.gov**.



Some notebook batteries may smoke and burn.

BURN, BABY, BURN

Both Dell and Compaq have recalled some 88,000 notebook computer batteries because they may spark fires.

Dell is recalling 27,000 notebook computer batteries, even though there was only one reported incident of a faulty battery starting a fire. That fire caused a minor amount of property damage but has prompted Dell to issue a recall. The Dog endorses Dell's decision.

The batteries were sold with Latitude CPiA, CPiR, CPtC, CPtS, CPxH, CPxJ, and Inspiron 3700 and 3800 notebooks. The batteries were sold between June 22, 2000 and September 15, 2000 in North and South America. In Europe, Africa, and the Middle East, the batteries were sold between June 22, 2000 and October 4, 2000.

For more information on the Dell battery recall visit **http://support.dell.com/battery** or call 877.741.6420.

Just after Dell announced its recall, Compaq said it also had a problem with some of its batteries. Roughly 55,000 battery packs used in Compaq Armada E500 and V300 notebooks could short-circuit, release smoke, or catch fire. Compaq said it has seen only one of the batteries short-circuit and smoke, but is issuing the recall as a precaution.

The batteries were issued with the Armada E500 and V300 notebooks and also sold as extras between June 2 and July 10, 2000. If you have an Armada E500 or V300, check the battery to see if it has a date code and serial number from this list: TCGK serial numbers 00001 to 10500; TCGK 20001 to 21800; TCGK 40001 to 83100; and TCHK 40001 to 44700.

"Now that WebTV came along, heck, who needs a computer?"

If your battery is affected, Compaq requests that you immediately stop using the battery. Compaq will replace the recalled battery with two new batteries for your trouble. For more information and a software utility to check your battery, visit **www.compaqordercenter.com/sbrp/cl.asp** or call 800.889.7613.

Compaq says there's no relationship between its battery pack problems and Dell's. Dell used Sanyo battery cells, and Compaq used Sony battery cells.

BAD DOG, BAD

Dear Dog: You need a smack on the nose with a rolled up newspaper for your gaffe in the September 2000 issue. You wrote that owners of bad Philips CD-R drives "can receive up to $200 in cash." Not true. They can receive rebate coupons (worth up to $200) that can be applied to a percent of the purchase price of up to two Philips, Magnavox, or Norelco brand products. Also, the claim form requires proof of former ownership of one of the listed drives, not the replacement drive, as stated in the article. In fact, it is not necessary to have replaced the drive; you are eligible if you simply tossed the technoscrap like a bad date and walked away. I love you

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guys and know you have a knack for pulling information out of the tightest spots, but I have to tell you that less than five minutes at the site you mentioned in the article disclosed these errors. OK, rebuke over. Get back out there and kick ass!

—Patrick E. Kelley

The Dog Responds: Arf. The Dog apparently misunderstood what the attorney in the case said about the settlement, and, unfortunately, at the time the column was written, the web site wasn't online, so there was no way to read the actual details of the settlement. You have The Dog's apology for the screw-up. Another reader also chimed in about the Philips CD-R settlement:

$200 for this coaster maker? Not.

Dear Dog: I was not surprised to read of the class action suit against Philips regarding the faulty CDD2000 and CDD2600 drives. Nor was I surprised by Philips unwillingness to admit culpability. I was, however, totally blown away by the solution the company offered to the consumers of those products.

"Will Alcam make it? The Dog wouldn't bet a bag of used chew toys on it."

To replace these drives with the CDD3610 is not only *not* a solution, but is an insult! The CDD3610 is a coaster generator of unsurpassed magnitude and is so wrought with problems that there are entire web sites devoted to the maintenance of these delicate machines. I spent literally hundreds of dollars on wasted media and dozens of hours on the phone with customer support before finally giving up and buying a new drive (the Kick Ass-rated TDK VeloCD). My advice: Do not accept this machine or, for that matter, any Philips CD-RW until the company's track record improves.

–Jay Glisson

ALCAM CLAMMED UP

Dear Dog: I purchased an Alcam notebook about a year ago, and four months later, the company disappeared. My notebook runs fine, but I've always wondered what the heck happened to this company. I think you should add Alcam to your list of "Missing in Action" companies that you ran in the October 2000 issue.

—Brendon McCarthy

The Dog Responds: Alcam should indeed be added to the list of MIA companies. The company filed for Chapter 11 bankruptcy protection on January 28, 2000, in the U.S. Bankruptcy Court in the Northern District of California. In June, the court approved a plan to bring the company back from the brink. Will Alcam make it? The Dog wouldn't bet a bag of used chew toys on it. Attorneys representing Alcam refused to comment on any aspects of the bankruptcy. Not all is lost, however, Brendon.

The Dog talked with PC company Total Peripherals, Inc. about its relationship with Alcam. Total Peripherals officials said it originally manufactured and sold a line of notebooks called the Alcam FX/XL notebooks. Total Peripherals eventually sold the Alcam name to a startup company in California that produced its own notebooks named the Alcam Designer and Alcam Executive series. As part of the deal, TPI also began selling the Alcam Designer and Alcam Executive notebooks and became involved in offering warranty and repairs on Alcam notebooks. After Alcam filed for bankruptcy, TPI still offered support for the notebooks but had to charge for support and repairs.

Drivers for Alcam's FX, XL, and Designer notebooks are available from **www.farang2.freeservers.com**, and some spare parts may be purchased from **www.3klix.com**. TPI officials were also gracious enough to provide info on who originally manufactured some of Alcam's notebooks. The Alcam Designer 400 series books were made by Clevo Computer Company. Clevo also made the Alcam Model 98, which was the Clevo Model 980, and the Alcam Model 980, which was the Clevo Model 982. The Alcam Designer 600 series is the same as Dual Technology Corp.'s VDA9900. Samsung apparently made the Executive 700 series. To contact TPI for service, visit **www.totalpc.com**.

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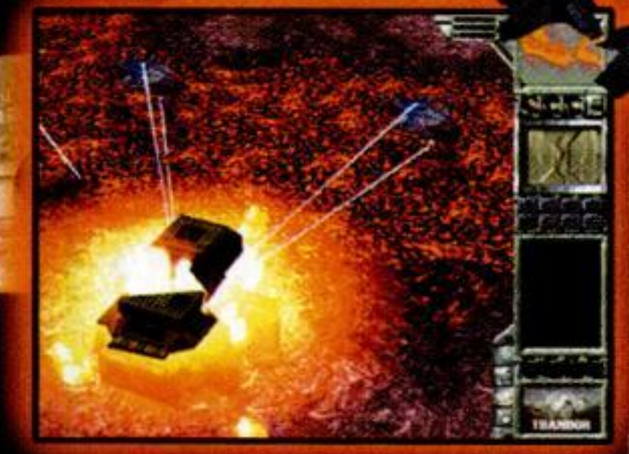

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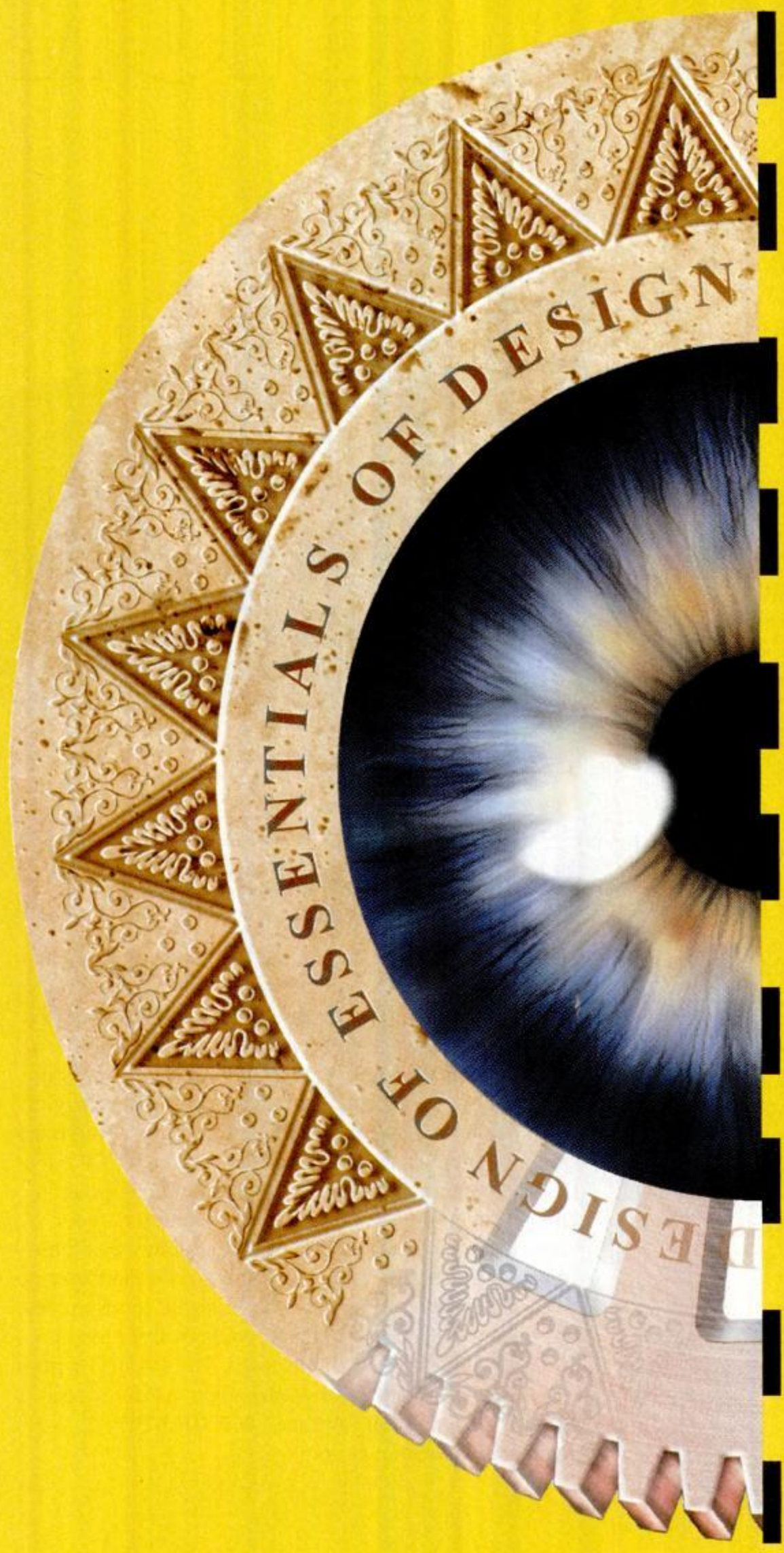

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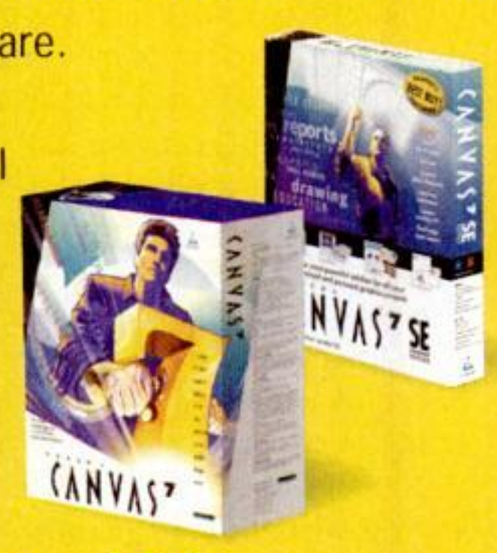

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▶TOMORROW'S TECHNOLOGIES EXPLAINED

FAST FORWARD

In 2000, microprocessors broke the gigahertz barrier. Ho-hum. What's next? How about high-end PCs and servers with dual Athlons, or Level-3 processor caches in system chipsets, or mobile processors from Intel that aren't recycled desktop chips, or low-end processors edging toward 1GHz?

That was the buzz at the latest Microprocessor Forum, an annual gathering of chipheads in Silicon Valley. There was also news about network processors, information-appliance processors, and exotic mainframe processors. But this is *Maximum PC*, not *Maximum Router*, *Maximum Terminal*, or *Maximum Mainframe*, so let's stick to PCs for now.

The mood at this year's forum was rebellious. AMD was soaring on the popularity of the Athlon, and Transmeta was on the verge of finally reaching the market with its Crusoe notebook processors. Intel was reeling from its chipset woes, aborted Timna project, embarrassing Pentium III recall, and manufacturing shortfalls. But anybody who expects Intel not to make a comeback probably thinks Amazon.com will turn a profit next quarter, too.

Hoping to capitalize on its new-found success, AMD is pushing the kick-ass Athlon for symmetric multiprocessing (SMP)—a direct assault on Intel's Xeon. AMD's new AMD-762 northbridge chip will tie a pair of Athlons into Double Data Rate (DDR) SDRAM, an AGP 4x graphics card, and a new southbridge chip. Note that AMD is resisting the Rambus religion that has caused Intel so much grief, preferring PC1600 and PC2100 DDR SDRAM instead. (For more about PC1600 and PC2100, see the bullet item below.)

2001: A Chip Odyssey

A PEEK INSIDE THE ROADMAPS OF AMD, INTEL, MICRON, AND VIA

Unlike northbridge chips for regular PCs, the AMD-762 has two frontside buses—one for each processor. Each frontside screams at 266MHz, twice as fast as a typical PC frontside bus, providing 2.1GB per second of peak bandwidth per bus. Technically, the Athlon frontside interfaces are point-to-point channels, not true multidrop buses. High-speed channels are easier to design than high-speed buses. One drawback of this design is the pin count. The AMD-762 has more than 900 pins, so it's costly to manufacture. But it works with economical four-layer motherboards instead of the more complex motherboards required by many other server processors.

Anybody who expects Intel not to make a comeback probably thinks Amazon.com will turn a profit next quarter, too.

Meanwhile, Micron Technology revealed a completely new kind of northbridge chip with an L3 cache. Why does a northbridge need an L3 cache? It doesn't. The cache is for processors like the Athlon, Pentium III, and Pentium 4 that already have on-chip L1 and L2 caches. Another twist is that Micron's L3 cache is embedded DRAM (eDRAM), not SRAM, which is the usual memory technology used for caches—eDRAM is slower but cheaper than SRAM.

Micron says it makes sense to put L3 cache in a northbridge because otherwise the chip will be half empty. It turns out that while new fabrication technology can dramatically shrink the size of northbridge chips, the growing number of pins required for buses is limiting how small the chips can get. So Micron aims to fill the empty space with L3 cache made of eDRAM—a whopping 8MB. That's more RAM than most PCs had in main memory a few years ago. Micron says the first northbridge chips with eDRAM are about a year away.

TOM HALFHILL was senior editor at *Byte* magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at **thalfhill@maximumpc.com.**

Intel revealed plans for entirely new mobile processors in 2002 that aren't simply recycled desktop processors—a radical departure from current practice. Apparently Intel is feeling the heat from Transmeta. No surprise. Intel optimizes today's chips for high clock frequencies, and the circuits leak so much power that a separate design makes sense for battery-powered systems.

VIA Technologies, which owns Cyrix and Centaur, is wooing the low-end market with a new line of under-$50 processors. Don't dis 'em, though. VIA says the Cyrix III will reach a respectable 867MHz in 2001. In 2002, a new design called the Centaur CX should hit 1.2GHz. That's good news if you're on a budget—but it does indicate that lean machines will lag behind dream machines by 12 to 18 months. ✹

Random Thoughts

▶ In a flash of marketing inspiration, the SDRAM folks are naming their specs after the peak bandwidth, not the bus frequency. So PC1600 DDR SDRAM is really PC100 DDR SDRAM, because the 100MHz bus transfers two bits of data per wire per clock (double data rate), which yields 1600MB (1.6GB) per second over a 64-bit bus (eight bits per byte, remember). Likewise, PC2100 SDRAM is really PC133 DDR SDRAM, because 133MHz multiplied by two bits per clock multiplied by eight bytes equals 2100MB (2.1GB) per second. "PC1600" and "PC2100" are supposed to sound more impressive than "DDR PC100" and "DDR PC133." What do you expect? It's advertising.

▶ PowerPC G4 chips in Macs are running only half as fast as the x86 chips in PCs. The G4's greater efficiency makes up some of the difference, but not all. To catch up, Motorola will manufacture future G4 chips with silicon-on-insulator (SOI) technology. But Apple doesn't like to pay much for CPUs, so it'll be a while before Macs hit 1GHz.

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▶ THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

T. LIAM MCDONALD is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com**.

Ever wanted to see your own pudgy, pale likeness in a game? A company called 3Q (**www.3qme.com**) has already rolled out the technology to make it happen. 3Q has taken the standard mall photo kiosk and refitted it with its Digital Surface Photogrammetry (DSP) technology. For $25, a light grid is superimposed on your face to create reference points as you sit in the booth, and three synchronized cameras snap an image. This image is converted into a 2,000-polygon model, which can then be exported directly to a CD-ROM. The file can be output as either VRML or, for an extra $5, directly to a specific game such as *Quake III* or *Half-Life*. The booths can be found at Babbage's in San Jose, Seattle, and Dallas (with more to come). Is this likely to catch on? Hard to say. The technology certainly functions well enough, and it allows you to manipulate the image by adding scars and changing facial features for a custom look. It's the kind of gimmick that could go over well with the massively multiplayer RPG crowd, allowing gamers to craft characters that more closely resemble themselves.

* * *

The Underdogs (**www.theunderdogs.org**) is a web site dedicated to "abandonware" and lesser-known titles. Its goal is to provide a resource for games that are out of print or no longer available (since game companies simply abandon games that are no longer cutting-edge). Unfortunately, the IDSA (the major software trade industry association) sees the Underdogs as endorsing piracy and is attempting to stomp it out. Until the IDSA starts seriously addressing the rapid loss of our gaming heritage by making older titles available, it should stop hindering the good work of true game lovers and fans. Motion pictures were routinely discarded in a similar fashion—some 90 percent of all silent films are now lost forever. (If you think the analogy to film is absurd, just remember that 80 years ago no one could conceive of someone ever wanting to watch a Laurel and Hardy short again. Now I, and many others, own what's left of them on DVD.) Games are going the same way, but instead of helping the people who are trying to prevent this, manufacturers and their trade industry are siccing slobbering packs of mad lawyers on them. It's a 21st-century *auto da fe*, and the IDSA is lighting the pyre.

* * *

Mention "Christian gaming" to any hardcore PC gamer and you're likely to get a dismissive snicker, and for good reason. Christian PC gaming has largely been limited to grade-Z Bible trivia software and a few crude, Biblically themed adventure games. *Catechumen* is neither of these. Developed by N'Lightning Software and using the open-source Genesis3D engine, it cloaks standard FPS gameplay in religious dress. As a persecuted Christian in ancient Rome, you must use a sword to convert, rather than kill, foes as you attempt to free your fellow Christians. Genesis3D is no *Quake*, but it's capable of acceptable 3D environments and it's easy to use. The models aren't half-bad for an independent project such as this, and while the gameplay may seem silly to the hardcore FPS crowd, they're not the market. Sold at Christian and Catholic bookstores (I *love* how people separate the two), it's aimed at the non-gamer. Not surprisingly, N'Lightning president Ralph Bagley says he was laughed at by pretty much every major game publisher when he shopped the title. Since there are hundreds of millions of Christians and a couple hundred thousand hardcore action gamers, can someone explain why a major publisher would dismiss a concept like this out of hand?

* * *

If you've been computing for a while, you may remember a tool called *Virtus Walkthrough*—"pre-visualization" software that enabled users to build and navigate environments. Primarily used by architects and for motion picture pre-production, it was one of the early 3D-environment editing packages. A company called Perilith Industrielle has taken this concept of realtime 3D business software to the next level with *Unreality* (**www.unreality .net**), which provides a set of tools and tutorials for creating real-world environments using the *Unreal* engine. It will even build your environment for you. The goal is to bring the power of *Unreal* to the business and educational realms, creating real-time 3D re-creations of architectural models, famous places, museums, and the like. One more example of the far-reaching power and capabilities of *Unreal*.

* * *

The *Links* series, once the gold standard of golf sims, has been coasting for several years now, bested by the *PGA Championship* and *Jack Nicklaus* series. But with *Links 2001*, the marquee finally delivers a competitive, striking, visually detailed golf game. More importantly, the latest version includes the long-promised course editor. Although it is actively user-hostile, with a terrible help system and bewildering menus, it's also *very* powerful, with hundreds of pre-made objects and countless editing parameters. You may not want to explore the complexities of golf course creation (often far more difficult than making levels for FPS games), but you know that plenty of other people will, finally giving *Links* an endless supply of user-made courses. ✹

6 Reports From the Edge

FORGET ABOUT "A" TITLES—THE FRINGE OF GAMING IS JUST AS COMPELLING

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"We **TOLD** you it wouldn't hurt."

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▶THE LATEST HARDWARE HACKING BUZZ

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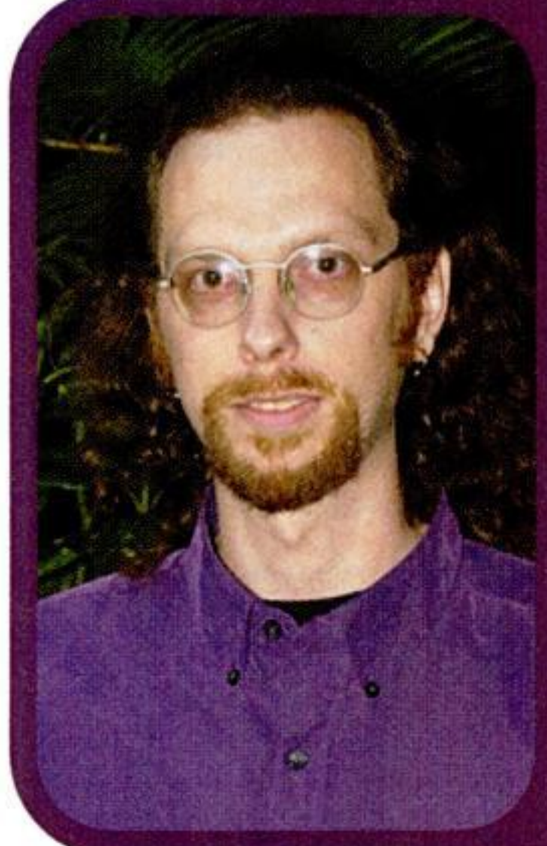

SCOTT TARR
is *Maximum PC*'s associate tech editor. He's quick with a soldering iron and is certified by the Environmental Protection Agency as a Refrigerant Technician TYPE II.Contact him at **starr@maximumpc.com**.

Exploring the Dark Side

WHY PAY FOR POWER WHEN YOU CAN SQUEEZE IT FROM EXISTING PARTS?

Welcome to the PC dark side, your trip into the underbelly of unabashed hardware hacking. Forget about paying exorbitant prices for nominal leaps in performance. Today we're talking about getting the mostest for the leastest—and doing it all by hand. From popping the 1GHz barrier with little or no effort to voiding your warranty by every means imaginable, this trip will bring you closer to your dream PC than you ever thought possible. Follow along as we break the shackles of conformity that control the average PC user.

To date, we've seen many hacks that push hardware to a higher level—everything from overclocking humble Celerons to turning IDE controllers into full-fledged RAID controllers with a few simple "adjustments." The latest hack du jour involves breaking the multiplier lock on AMD's Socket A processors. The most notable method is the "pencil trick." Do it correctly, and you can overclock your proc *without* mussing the system bus settings.

In the latest AMD Durons, the L1 bridge is cut at the factory to "lock" the processor's multiplier setting, thus discouraging overclocking. However, with a common 2B lead pencil, you can reconnect the bridge to override the lock. Barbaric, yes, but it works—sometimes. Some Durons don't like to cooperate. Thus, the hacking underground developed a revised method. Enter our AMD motherboard pick for Gear of the Year, the Asus A7V.

Early versions of the A7V come with a DIP switch that, when flipped, allows locked processors with closed L1 bridges (that is, early or penciled Durons) to break the chains of convention. Unfortunately, later A7V boards lack the DIP switch. Asus removed the switch to stymie overclocking enthusiasts and to keep unscrupulous vendors from selling "re-marked" systems with overclocked procs for a premium. However, even later A7Vs can be modified to work with pencil-tricked Durons. It's a simple matter of soldering on your own DIP switch and adding a resistor to the motherboard—in effect turning your later-model A7V into an early-model A7V.

As soon as one company attempts to nullify a hardware hack, the hacker denizens rally to render the nullification irrelevant.

Higher clock speeds introduce voltage issues. As competent as the Asus A7V might be, it's still limited to a maximum of 1.85 volts, and, as you push your proc to higher speeds, more voltage must be fed to the CPU or the poor proc will starve. Enter Frank Völkel, who's come up with a way to add a resistor to the A7V for modifying voltage above the official spec. All you need is a soldering iron, a few parts, and a bit of skill. The project involves adding a simple resistor to the riser board that sits next to the proc. In our November 2000 review of the A7V, we complimented the riser board because it precludes the implementation of towering transistors that could easily be broken, thus destroying the board. Now it looks like the riser board makes implementation of voltage hacks easier, too.

Hardware hacking isn't limited to Asus' awesome A7V. The current fan-fave Socket A board from Abit, the KT7-RAID, slid under the tweaker's microscope as well. In a trick similar to Völkel's A7V voltage mod, adding a resistor to the KT7-RAID allows for tweaking proc power requirements beyond Abit's specs.

Of course, overclocking generates excessive heat, so it makes sense that overclocking projects would spur new cooling methods. Water-cooling has caught on among extreme overclockers, but most of these tweakers are using aquariums that sit beside the computer case, a strategy which consumes far too much of my precious workspace. For this very reason, I'm sharing my heat pipe project on page 65. Warning: Like many wacky cooling projects, the heat pipe scheme requires a steady hand and could result in an accident that destroys your high-dollar motherboard and processor. You are henceforth warned, and I'm absolved of any and all damage that may be incurred.

All in all, the trip toward hellacious hardware hacking marches on. As soon as one company attempts to nullify a hardware hack, the hacker denizens rally to render the nullification irrelevant. This isn't about attacking "corporate interests" or "stealing performance." It's about the thrill of the hack and doing it yourself. And there you have the mission of this column. When you see my plotting face in the upper right-hand corner of the page, you know you're in for a PC thrill ride. ✹

Online Resources

▶ The step-by-step instructions for the pencil trick can be found at **http://myhome.netsgo.com/wesleycrushr/Hardware/ovr000803a-1.htm**.
▶ The A7V proc-unlock hack can be found at **http://www6.tomshardware.com/howto/00q3/000808/index.html**.
▶ For delving into the A7V's voltage mod, check out **http://www.insanehardware.com/articles.php?i=8**.
▶ That KT7-RAID voltage hack can be found at **http://www.amdzone.com/articleview.cfm?articleid=368**.

(NOTE: All URLs were valid at press time.)

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Introducing...

PENTI

Intel's first new processor core in six years reaches astonishing clock speeds. But does an extra 500MHz really pay off in noticeable performance dividends? Here's everything you need to know about the vaunted P4.

When AMD broke the 1GHz barrier, *Maximum PC* Editor-in-chief Jon Phillips declared that he'd take a 150MHz clock speed increase over any core architecture benefit that a processor company could offer. That statement appeared in a May 2000 editorial—times have since changed. In mid-2000, the core architectures of the top procs from AMD and Intel were sufficiently similar for Phillips to make such a sweeping statement. But now, with the advent of the Pentium 4, the entire clock speed-vs.-core architecture question has been turned upside down. The P4's core architecture is expressly designed to reach unprecedented clock speeds, but, in a wacky twist of circumstance, attributes of the core also bog down performance in some applications.

In the next few pages, we'll tell you the entire P4 story, review two new P4-based systems, and show you how the P4 stacks up in a battle of the benchmarks. Read on and read carefully—your next upgrading decision might depend on whether the quirky P4 is right for you.

How is the P4 different from the Pentium III?

For starters, Intel dropped its Roman numeral numbering convention. It seems the company was concerned that many people are incapable of counting to four in Roman numerals. Seriously.

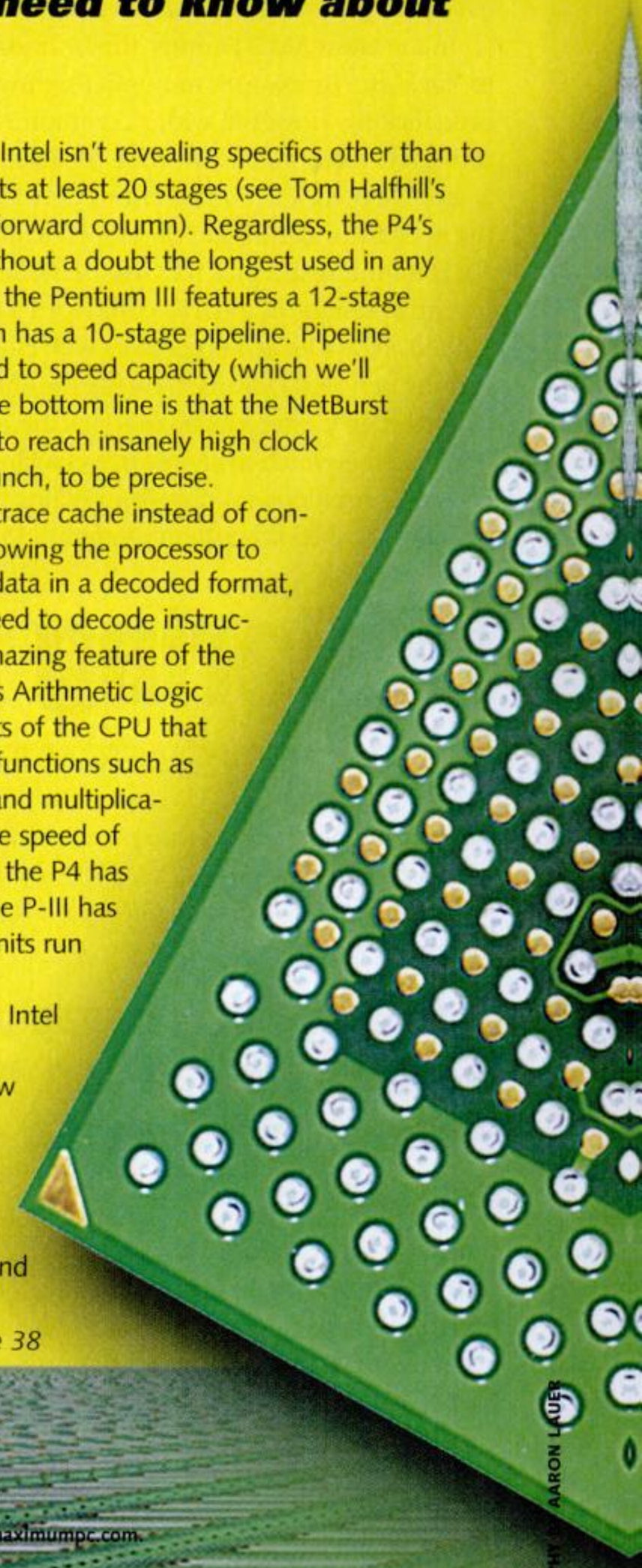
The P4's new core architecture—dubbed NetBurst—is also the first truly new 32-bit processor core introduced by Intel since the P6 core launched in 1995. The P6 initially appeared in the Pentium Pro and was revamped for the Pentium II, Celeron, and Pentium III lines. Make sure you never confuse the NetBurst core with the P7 core, because P7 is the designation for the upcoming 64-bit Itanium processor.

One of the P4's most significant features is its incredibly long processing pipeline. The precise number of pipeline stages is difficult to determine, and Intel isn't revealing specifics other than to say that the pipeline hits at least 20 stages (see Tom Halfhill's November 2000 Fast Forward column). Regardless, the P4's NetBurst pipeline is without a doubt the longest used in any mass-production CPU; the Pentium III features a 12-stage pipeline and the Athlon has a 10-stage pipeline. Pipeline length is directly related to speed capacity (which we'll explain shortly), but the bottom line is that the NetBurst pipeline allows the P4 to reach insanely high clock speeds—1.5GHz at launch, to be precise.

The P4 also uses a trace cache instead of conventional L1 cache, allowing the processor to store instructions and data in a decoded format, thus eliminating the need to decode instructions. Another truly amazing feature of the NetBurst core is that its Arithmetic Logic Units (ALUs)—the parts of the CPU that perform integer math functions such as addition, subtraction, and multiplication—clock at twice the speed of the CPU. So, although the P4 has just two ALUs while the P-III has three ALUs, the P4's units run twice as fast.

Finally, with the P4, Intel has extended the SSE instruction set; 144 new "SSE2" instructions will use SIMD strategies to speed up performance in SSE2-enabled games and applications.

▶ *See page 38*



PHOTOGRAPHY: AARON LAUER

* For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

P4

by Gordon Mah Ung

SPECS

Transistors: 42 million
Core Voltage: 1.75 volts
Wattage: 53 watts (at 1.5GHz)
Die Size: 218mm^2
Packaging: Revised FC-PGA in a 423-pin socket
L1: 12KB micro-op cache, 8KB data cache
L2: 256KB on-die cache
Price: 1.5GHz, $819/lots of 1,000; 1.4GHz, $644/lots of 1,000

PENTIUM 4

Dell Dimension 8100

DELL ATTACKS WITH SILVER AND BLACK

Do good guys wear black? Yes, they do. Witness Dell's new 8100 Dimension. Under its silver and black case, the 8100 sports an Intel Pentium 4 wedded to nVidia's GeForce2 Ultra card. This love child spit out the fastest *Quake III Arena* frame rates we've ever seen. In fact, the P4/GeForce2 Ultra combo bested the record set by the beautiful Voodoo PC on page 76.

PLUSES
- Beautiful 19-inch P991 flat-tube monitor
- World's fastest gaming card
- Nice case and power supply revisions

MINUSES
- Proprietary motherboard
- Smallish hard drive

The 8100 is itself a tour de force of state-of-the-art technology: 1.5GHz Pentium 4, Creative Labs' Annihilator2 Ultra card, 12/8/32 CD-RW drive, and 128MB of PC800 RDRAM memory sitting on a dual-channel memory bus, care of Intel's new 850 chipset. Despite this marquee list of components, we found the 8100 wanting. For one, the NEC DV-5700A DVD drive proved to be a mixed bag. While it extracted audio faster than the Compaq's drive, it was slightly slower in *CD Tach*. The Western Digital WD400BB 7,200rpm ATA/100 drive also can't hold a candle to the Presario's IBM Deskstar.

Dell loaded the 8100 with Win2000 to squeeze as much as possible from the Pentium 4. Windows Millennium, it seems, can degrade performance simply by breathing, so Dell went with the option that would cast its new machine in the brightest light. In *SYSmark 2000*, the 8100 ran circles around the WinME-powered Presario and hit performance numbers akin to what one would expect from a 1.1GHz Athlon or 1.1GHz P-III in office apps. Remember, the P4 isn't designed to be a barn-burner in ho-hum integer apps. On the flipside, the Presario outran the Dimension in our *3DMark 2000* Direct3D test by almost 13 frames per second. Why was the Dell faster in *Quake III* but slower in *3DMark*? Since both machines have the same videocards, we can only chalk it up to Win2000 drivers.

In the audio department, Dell took an eccentric course. Instead of going with the obligatory Sound Blaster Live!, Dell opted for Turtle Beach's new Santa Cruz. The Santa Cruz offers both 5.1 analog and digital support and has a nifty "Versajack" that allows you to use headphones alongside all four speakers. Dell bundled the Santa Cruz with a set of ADA885 Dolby Digital 4.1 speakers. This set was impressive in early 2000, but better designs have emerged, and now the ADA885s sound pale in comparison, despite their THX certification.

While, at press time, the Intel 850 appears to be a "controversy-free" core-logic chipset, in the 8100 it sits on a proprietary Dell-commissioned mobo—good luck upgrading with another company's mobo. But here's a nice change: Gone is the wimpy 200-watt power supply that Dell used in many of its Pentium III systems. The 8100 features a beefy 330-watt supply to feed the power-hungry Pentium 4. Cooling, meanwhile, is deftly handled by a wicked-looking green fan shroud that encloses the processor. Dell also introduced a nice new case design. You can pop it open with a front-mounted button, and the power supply and hard drive cage swing out for servicing.

The 8100 has room for improvement, but, along with the Compaq, it stands as one of the fastest gaming machines we've ever played with.

TEST	ZERO	DELL	RESULTS (%)	RANK
SYSmark	174	206	18.3	LEADER
Hard Drive	20.2MB/sec	23.7	17.3	Unseeded
CD-ROM	26x	26.6x	2.3	Unseeded
Photoshop	170sec	105sec	38.2	LEADER
Direct3D	38fps	87.6fps	130.5	2nd Seed
OpenGL	34.4fps	121.1fps	252.89	LEADER

Full benchmarking details at www.maximumpc.com/benchmarking/index.html.

UNDER THE HOOD

THE BRAINS	
CPU	Intel Pentium 4
L2 cache	256K full speed
RAM	128MB PC800 RDRAM (2GB max)
Motherboard	Dell
Drive bays	Three 5.25-inch, two internal 3.5-inch
I/O ports	Four USB I One parallel I One serial
DISPLAY	
Video	Creative Labs Annihilator2 Ultra 64MB DDR SDRAM
Monitor	19-inch Dell flat screen aperture grill
Refresh@ max res	1600x1200@85Hz
STORAGE	
Hard drive	40GB Western Digital
DVD	NEC DV-5700A
CD-RW	Sony CRX-160E
Removable	3.5-inch floppy drive
NETWORKING	
Fax/modem	Onboard 3Com 3C920C 10/100 on motherboard
SOUND	
Soundcard	Turtle Beach Santa Cruz
Speakers	Altec Lansing ADA885
THE BUNDLE	
Microsoft Windows 2000 I *Word 2000* I *Excel 2000* *PowerPoint 2000* I *Easy CD Creator 4.0* I *Norton Antivirus 2000* I *WinDVD*	

BOOT **0:53** DOWN **0:25**

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Compaq Presario 7000

GOODBYE PROPRIETARY PARTS, HELLO GAMING PERFORMANCE!

If you've ever owned a Compaq PC, you're familiar with the company's penchant for custom-designed, upgrade-defying hardware. Well, that was the *old* Compaq. With the Presario 7000, Compaq's top-of-the-line PC, the company takes serious steps to end its heritage of using proprietary components—which is exactly what power users deserve.

PLUSES
- GeForce2 Ultra
- Klipsch speakers
- Onboard FireWire

MINUSES
- Only 8x CD-RW
- Slow *SYSmark2000* scores.

What's so bad about proprietary parts? Well, for one, if a component ever fails, you can only buy replacement parts (such as a power supply or motherboard) directly from the system vendor. Likewise, regular-old performance upgrading is equally restrictive. Compaq's new design isn't completely devoid of proprietary parts, but we recognize that the company is trying.

The most glaring problem with the otherwise worthy Presario is its sub-par score of 172 in *SYSmark 2000*, a suite of 12 business and content creation apps. Why such a big performance disparity between the Dell and Compaq? Blame it on Windows "Suck Your Resources" Millennium. Microsoft's latest consumer OS likely dragged down the Presario's scores in both *SYSmark 2000* and our own Adobe *Photoshop* test. But luckily for Compaq, the Presario emerged as the second fastest *Quake III* box we've ever seen, trailing the Dell 8100 by just 2fps. The Presario also kicked ass in Direct3D by pushing 99.4fps in *3DMark 2000*. This trumps the Voodoo system by 24fps and the Dell system by 13fps. Moral of the story: The P4 is the best 3D gaming CPU, and WinME Direct3D drivers beat their Win2000 counterparts.

Our Presario review unit came with an 8/4/32 CD-RW drive. In this age of 12x IDE burners, that's yesterday's news. However, Compaq didn't scrimp elsewhere. The Presario's awesome 75GB Deskstar 75GXP hard drive is well complemented by the system's native FireWire support. The FireWire is based on Texas Instrument's IEEE-1394 chipset, so Adobe *Premiere 5.1* folks may have issues, but *Premiere 6.0* is scheduled to finally address the lack of IEEE-1394 chipset support.

In fact, because the Pentium 4 performs so well in bandwidth-heavy applications, the Presario 7100 is perfectly suited for digital video production—feed in your DV stream via FireWire, encode it via the P4's supercharged architecture, and save it to the massive hard drive.

In the audio department, Compaq took no chances with Creative Labs' Sound Blaster Live! Value and Klipsch's ProMedia speakers. It's a tried and true combo that pumps massive amounts of thump. Overall, we're impressed by the new Compaq design; even the pop-out CD-ROM holder is useful. The Presario also sports a 300-watt power supply. We're disappointed by the lackluster *SYSmark2000* and *Photoshop* scores, but for gaming and video editing, the Presario is a sure bet.

UNDER THE HOOD

THE BRAINS	
CPU	Intel Pentium 4
L2 cache	256K full speed
RAM	128MB PC800 RDRAM (2GB Max)
Motherboard	Compaq
Drive bays	Three 5.25-inch, one external 3.5-inch bay, two internal 3.5-inch
I/O ports	Four USB ports I Three IEEE-1394 ports
DISPLAY	
Video	Creative Labs Annihilator2 Ultra 64MB DDR SDRAM
Monitor	19-inch MV940
Refresh@ max res	1600x1200@60Hz
STORAGE	
Hard drive	75GB IBM Deskstar 75GXP
DVD	Compaq DVD-115
CD-RW	Philips CDD 4801
Removable	3.5-inch floppy drive
NETWORKING	
Fax/modem	SMC EZCard 10/100 Conexant PCI modem
SOUND	
Soundcard	Creative Labs Sound Blaster Live! Value
Speakers	Klipsch ProMedia v.2-400
THE BUNDLE	
Microsoft Money, Word, Works, Encarta I McAfee Antivirus I Easy CD Creator I MyMovieSTUDIO I MyDVD I Studio DV *Digital Imaging Software*	

BOOT **0:45** DOWN **0:06**

TEST	ZERO	COMPAQ	RESULTS (%)	RANK
SYSmark	174	172	-1.1	Unseeded
Hard Drive	20.2MB/sec	28.9MB/sec	43.0	Unseeded
CD-ROM	26x	27x	3.8	Unseeded
Photoshop	170sec	115sec	32.3	3rd Seed
Direct3D	38fps	99.7fps	162.3	LEADER
OpenGL	34.4fps	119fps	245.9	2nd Seed

Full benchmarking details at **www.maximumpc.com/benchmarking/index.html**.

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How does the P4 achieve such high clock speeds?

CPUs with long pipelines are inherently friendlier to high clock speeds than CPUs with short pipelines. Just consider Apple's Motorola PowerPC G4, which has been stalled at under 500MHz for a year. Why the 500MHz ceiling? Think of the CPU pipeline as an assembly line in a car factory:

At the G4 factory, there are only five stages in the assembly line. This means only five workers toil to assemble the car, and each worker must complete several tasks before the car can move to the next stage in the line. The overall output of cars-per-day will be directly affected by the slowest worker in the assembly line.

Over at the P4 factory, cars pass through more than 20 assembly stages. At each stage, the worker performs a relatively small amount of work and then sends the car on to the next stage. Because each worker has a simpler task to complete, cars can move through the line much faster and pop off with greater frequency.

In short, by lengthening the pipeline and simplifying the work completed in each pipeline stage, the CPU can ramrod instructions through the core at a greater frequency. This is an oversimplification, of course, and other aspects of the G4 and P4 affect each individual CPU.

What are the drawbacks of a longer pipeline?

You pay a bigger penalty for bad branch prediction. Branch prediction is the CPU function that makes an educated guess at the outcome of a branch decision (for example, when a dialog box with "OK" and "Cancel" buttons appears in Microsoft *Word*, it represents a branch decision, and each button represents a different instruction). Correctly predicting a branch decision allows the CPU to execute multiple instructions in parallel, which is a great asset to overall performance. However, a misprediction means the CPU will have to flush its pipeline (which consumes processor cycles) and start from scratch in order to carry out the correct instruction.

In the P4's massive pipeline, the processor doesn't check for mispredicted branches until the penultimate assembly line stage. To continue with the car assembly line analogy, if the wrong windshield is fed into the pipeline, the entire assembly line must be cleared of parts and refilled before work can begin again. A shorter assembly line can therefore recover from branch mispredictions much faster than a longer assembly line. Intel says it has invested heavily in improving its branch prediction algorithms—precisely because its pipeline is so long.

So between the high clock speeds and the idiosyncrasies of branch prediction, how does the P4 perform?

The 1.5GHz P4 is without a doubt the highest performing 3D-gaming CPU we've ever tested. Games that make a 733MHz P-III squeal like a pig don't even dent the P4 at high resolutions. However, in Microsoft *Office* and other branch-heavy office applications that haven't been optimized for NetBurst idiosyncrasies, the P4 turns from Superman into Clark Kent. In fact, the 1.5GHz P4 machines we've seen so far would have a hard time out-boxing 1GHz Athlons and P-IIIs in some applications.

But Intel is betting the farm that you'd rather have better graphics in the next blockbuster from id Software than have Microsoft *Word* buzz through a mail merge two seconds faster. In fact, because office apps essentially lack any tangible speed problems in the first place, it's doubtful that anybody will see a "performance decrease" when running those apps on a new P4. Nonetheless, the P4 is indeed a poor office app performer on paper; see the benchmark analysis on page 40 for specifics.

Besides games, what good is the P4 to regular-old consumers?

Since the P4 is heavily fortified for the floating-point operations that fuel 3D graphics, Intel believes we'll finally have enough firepower to enter the "Visual Internet." That's Intel market-speak for full-on 3D web pages that actually look and function like those Hollywood computer interfaces of spinning 3D buttons and icons. Of course, this will require someone to invent a 3D GUI that everyone understands and wants. For a glimpse of where the web is going with 3D, check out **www.wildtangent.com** and **www.cult3D.com**. Like the P-III, the P4 is also a top performer in applications that take advantage of SIMD strategies—namely, voice recognition and multimedia encoding/decoding.

At what frequency will the P4 architecture top out?

Intel won't reveal specifics on the P4's redline, but states it wants to get from three to five years of life from the NetBurst core (which is the same amount of life it squeezed from the P6 core). The P6 core started with a top speed of 200MHz (in the Pentium Pro) and is now topping out at 1GHz in the Pentium III. If we extrapolate NetBurst in a similar fashion, one might expect the new core to reach 5GHz and beyond. At one press conference, Intel officials implied that 10GHz wouldn't be crazy for the NetBurst core.

There are already rumors of a 1.7GHz on tap for Q1 2001 and 2GHz by the middle of 2001. (Intel denies these reports.) For what it's worth, in one P4 OEM system we tested, the BIOS supports speeds up to 2.3GHz.

What about P4 motherboard chipset support?

The P4 will initially ship only with the 850 "Tehama" chipset. The 850 features dual-channel RDRAM support, a 400MHz data rate system bus, AGP 4x support, ATA/100, two 12MB/sec USB controllers (for a total of four USB ports), six-channel AC97 audio support, and 10/100Mbps Ethernet.

Intel hasn't yet licensed any third-party vendors to create chipsets for the P4. By the same token, Intel hasn't ruled out such support. Remember that Intel mainly makes money from selling CPUs, not chipsets.

Chipset issues aside, why can't I plug a P4 into my existing motherboard?

The P4 is a radical departure from previous Intel designs and requires a new 423-pin socket (not to mention RDRAM memory). The P4 is not compatible with Slot 1 or Socket 370 boards and marks the return of Intel to sockets for *all* of its desktop CPUs. In fact, you'll probably need a new power supply because of the P4's increased voltage needs. On Intel's Garibaldi mother-

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board, there are additional 12-volt and 3.3-volt power plugs that require a new ATX12V-spec power supply.

Is the P4 permanently married to RDRAM?

At launch, the P4 will ship with support for only Direct RDRAM memory. Since its introduction in late 1999, RDRAM has drawn fire for being excessively expensive without improving performance. Some detractors say RDRAM actually hurts performance. Some of the criticism may have been warranted when the P-III was originally coupled with the first RDRAM chipset, the i820, which runs a 133MHz system bus. But the P4's memory bus sends four pieces of data for every clock cycle, giving it an effective 400MHz bus frequency. At the new bus speed, it would appear RDRAM finally delivers outstanding performance in many bandwidth benchmarks. (RDRAM currently hits 800MHz, while conventional SDRAM tops out at 133MHz.)

However, due to the cost of RDRAM, the P4 won't remain a monogamous chip. Intel has already announced support for PC133 SDRAM and is likely working overtime to get Double Data Rate (DDR) SDRAM in place for the P4. Intel doesn't want consumer resistance to RDRAM to hurt P4 sales and is publicly lashing out at RDRAM's developer, Rambus, for some of the legal moves it has made. DDR SDRAM on P4 mobos should be a reality before the end of 2001.

So my investment in RDRAM is still good with the P4?

Yes and no. The 850 chipset only supports RDRAM at PC600 or PC800. If you place PC700 RDRAM in an 850 mobo, the memory will clock down to the lowest grade at 600MHz. Why? Because PC700 (356MHz x 2) doesn't cleanly divide into the 400MHz (100MHz x 4) bus. Drat and double drat.

Does the CPU employ new process technology?

No. The P4 is based on the same 0.18-micron process that the Coppermine P-III is built on. By the middle of 2001, Intel is expected to have in place its 0.13-micron process using copper interconnects.

Is the P-III kaput?

Not yet. Intel plans to move the P-III to a 0.13-micron process next year and will continue to push the P-III up in speeds. Also expected this year is a P-III with a much larger, full-speed L2 cache. The codename for this chip is Tualatin, and its DDR chipset is reported to be called Almador.

Does the P4 support SMP?

At launch, the P4 chipset will *not* feature dual-proc support. Intel says the P4 can indeed support SMP, but that will only be offered with the future workstation/server version of the chip. Cynical observers say Intel wants to make sure that if you're building a workstation, you'll be paying workstation prices. Of course, with AMD expected to release its first dual-Athlon chipset early this year, Intel may rethink its roadmap.

Will I need new software and drivers to realize the P4's potential?

Yes and no. The P4's architecture, clock speed, and floating-point advantages will certainly give you a speed increase if you were to upgrade from, say, a 500MHz P-III. To get the utmost performance from a P4, however, developers will need to recompile code with the latest compilers and add support for the new SSE2 instructions.

While the original SSE instructions digest data in 64-bit chunks, some SSE2 instructions can handle 128-bit chunks. This means that, in some cases, the P4 can handle twice as much work as a P-III, which effectively doubles the capacity of its floating-point and MMX units. A few dozen software titles already offer SSE2 support (see Intel's web site for details); nVidia's Detonator 3 drivers already support SSE2, and support will soon be added to DirectX 8.

What issues should home enthusiasts be concerned with when building a P4 box?

The P4 won't be the canned heat that everyone thought it would be. Of course, you don't want to build a P4 box in a mini-tower jammed tight with cables, but you don't need to resort to exotic cooling strategies just yet. At 1.5GHz, the P4 consumes 53 watts of power, a heat factor you can easily cool with adequate airflow and quality heatsinks and fans. As the clock speeds increase, however, you'll need to pay serious attention to airflow and thermal management.

You'll also need to be concerned about the heat your memory generates. With the increased bus speed, your RDRAM will be hotter than ever before. Don't layer IDE and SCSI cables on top of your RAM, watch your airflow, and invest in a quality copper-skive heatsink instead of the $5 job you got out of the vending machine.

THE BENCHMARKS

Pentium 4 Offers a Mixed Bag of Tricks

If you've been chanting the "clockspeed is king" mantra, be prepared for a curve ball with the Pentium 4. While we can easily say that the 1.5GHz P4 is the highest-performing 3D-gaming CPU we've ever tested, it runs on par with a 1GHz P-III (or slower) in office apps and software that hasn't been optimized for the NetBurst core. Confused? Don't be. Intel says it designed the P4 to be faster in the emerging applications that will demand more and more performance during the next few years, such as media encoding and 3D gaming. In this respect, the P4 is just as Intel promises—überfast in floating-point-intensive applications.

In the following paragraphs, we compare the P4 to the fastest available Athlon CPU/memory/chipset combination we could get our hands on. For obvious reasons, this is very much an apples-to-oranges comparison: The CPUs, memory buses, and memory run at different speeds (by Intel and AMD design, not by *Maximum PC* choice). Our Intel system had a 1.5GHz P4, a 400MHz bus, and 256MB of PC800 RDRAM. Our AMD system had a 1.2GHz T-bird Athlon, a 266MHz bus, and 256MB of PC2100 DDR SDRAM (which essentially runs at 266MHz). Both systems had the same OS, videocard, videocard driver, and hard drive. Despite the wacky config differences, the match-ups do tell an interesting story—not so much when the P4 triumphs, but rather when the P4 fails despite its 300MHz speed advantage on paper.

First up, the good news for Intel. With

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audio disabled and resolutions turned down to reduce the impact of the soundcard and videocard on frame rates, the P4 belted out an incredible 209fps in *Quake III Arena* and kicked ass in the OpenGL game *MDK2*. We also saw the P4 take the speed crown in a SETI benchmark. Using a single unit (available from Teamlambchop.com), the E.T.-hunting software measures how long it takes to process the unit. The P4 spit the unit out in an amazing 150 minutes.

In synthetic bandwidth benchmarks, the P4 and its RDRAM buddy downright shattered previous scores recorded in SiSoft *Sandra*. Likewise, the new Intel architecture was victorious (as expected) in Windows *Media Encoder* and the Dragon *NaturallySpeaking* speech recognition program—two applications that Intel uses to demonstrate the unique power of its proc.

But leave it to AMD to pee on Intel's P4 parade. The Athlon is clearly faster in everyday applications such as *Office 2000* and spanked the P4 in most of the individual *SYSmark 2000* tests. Yes, despite the P4's double-clocked math units running at 3GHz, the Athlon still beat the P4 in *Bryce 3D*, *Elastic Reality*, *MusicMatch*, and even *Inspire3D*, which has traditionally favored Intel silicon.

AMD has always said that *Inspire3D* doesn't take advantage of the Athlon's schema for executing floating-point calculations in parallel, that the software was actually *de*-optimized for the Athlon architecture. Now Intel is croaking the same thing. Regardless, the message is clear: The P-III clearly trumps the P4 in *Inspire3D*—which leads us to wonder how many *other* random applications will suffer a similar setback.

Indeed, optimized software code is more important than ever. While the Athlon was faster when converting WAV files to MP3 using *MusicMatch*, the P4 took the lead when performing similar activities in Canon's *eJay MP3 Plus* encoder. Sure enough, the 1.3 version of *eJay* includes optimizations for the P4's 144 new SSE2 instruction sets. A similar thing happened in Adobe *Premiere 5.1*. When running the basic *Premiere* version in *SYSmark*, the Athlon slammed the P4 to the mat. But when running Intel's own *Premiere* benchmark—which uses the SSE2-enabled LIGOS MPEG2 encoder—the P4 whacked around the Athlon.

Even when running exactly the same software versions, we saw the balance of power shift just by running different action scripts. For example, the P4 triumphed in *SYSmark's* native *Photoshop 5.5* script, while the lower-clocked Athlon triumphed in *Maximum PC*'s own *Photoshop 5.5* action script (our script likely makes fewer SSE calls than the *SYSmark* script).

So what's the bottom line? Actually, there are three:

▶ The P4 is not an Athlon killer. The Athlon is faster in many applications, far less expensive, and currently shipping in volume.

▶ The P4 kicks ass in 3D games and next-gen "multimedia" applications that you may or may not have a use for.

▶ The P4 sucks in tried-and-trued business applications—but since these apps run fast enough anyway, you'll probably never even notice a slowdown in everyday use.

Given the current software landscape, we can't enthusiastically recommend a P4 purchase at the present time. But if the world of computing plays out as Intel anticipates, the P4 is your CPU of the future. ✹

DARE TO COMPARE BENCHMARK	1.5GHZ PENTIUM 4	1.2GHZ ATHLON DDR
Quake III 640x480 Normal3 (sound disabled)	209.5fps	175.4fps
MDK2 640x480[3]	183fps	160fps
3DMark 2000 CPUMark	457 Marks	437 Marks
Rage Incoming Forces[1,2,4]	44.7fps	30.8fps
SETI test 3.0 CLI	150 min	167 min
3DMark Video *3D Mark* 2000	37.6fps	32.4fps
SiSoft Sandra CPU	1552	565
SiSoft Sandra FPU	1584	679
SYSmark 2000 *NaturallySpeaking* pref 4.0	76.02 sec	82.08 sec
SYSmark 2000 Windows *Media Encoder* 3.0	33.35 sec	48.28 sec
SYSmark 2000 Overall Score	199	236
SYSmark 2000 *Power Point* 2000	69.23 sec	51.38 sec
SYSmark 2000 *Word* 2000	93.10 sec	79.41 sec
SYSmark 2000 *Excel* 2000	64.42 sec	48.36 sec

DARE TO COMPARE BENCHMARK	1.5GHZ PENTIUM 4	1.2GHZ ATHLON DDR
SYSmark 2000 Netscape *Communicator*	86.98 sec	67.54 sec
SYSmark 2000 *Bryce* 4	73.97 sec	58.40 sec
SYSmark 2000 *CorelDraw* 9	91.64 sec	68.57 sec
SYSmark 2000 *Elastic Reality* 3.1	43.64 sec	35.06 sec
SYSmark 2000 *Paradox* 9.0	101.82 sec	76.48 sec
Inspire3D	297 sec	195 sec
Music Match 5.0	69 sec	61 sec
Canon *eJay MP3 Plus* 1.3	47 sec	56 sec
SYSmark 2000 *Adobe Premiere* 5.1	98.59 sec	56.74 sec
Adobe Premiere 5.1 w/LIGOs MPEG2 Encoder[1]	55.4 sec	75.3 sec
Adobe *Photoshop 5.5* MPC Actions	117 sec	104 sec
SYSmark 2000 *Photoshop* 5.5	72.72 sec	79.92 sec
SiSoft *Sandra* Dhrystone	2839	3331
SiSoft *Sandra* Whetstone	887	1665

NOTES: [1] This benchmark was provided by Intel's Application Launcher 1.2., which is used to show the power of SSE and SSE2 instructions. [2] T&L inactive. [3] T&L active. [4] The *Incoming Forces* demo widely employs next-gen 3D technologies such as NURBS and 3D fractals; 3D objects based on these technologies are generated dynamically by the CPU and neither require, nor are compatible with, traditional polygon-oriented hardware T&L.

TESTING CONFIGS: Each platform was loaded with drivers to best expose the power of its respective processor. P4: 1.5GHz Pentium 4 with 400MHz FSB; 850 chipset on "Garibaldi" motherboard; 256MB of PC800 RDRAM; Windows 98SE; 7,200 IBM Deskstar; GeForce2 Ultra with 6.31 Detonator drivers; DX7B. Athlon: 1.2GHz Athlon with 266MHz FSB; 760 chipset on "Corona"; 256MB of PC2100 DDR SDRAM; Windows 98SE; 7,200 IBM Deskstar; GeForce2 Ultra with 6.31 Detonator drivers; DX7 plus AMD DLL.

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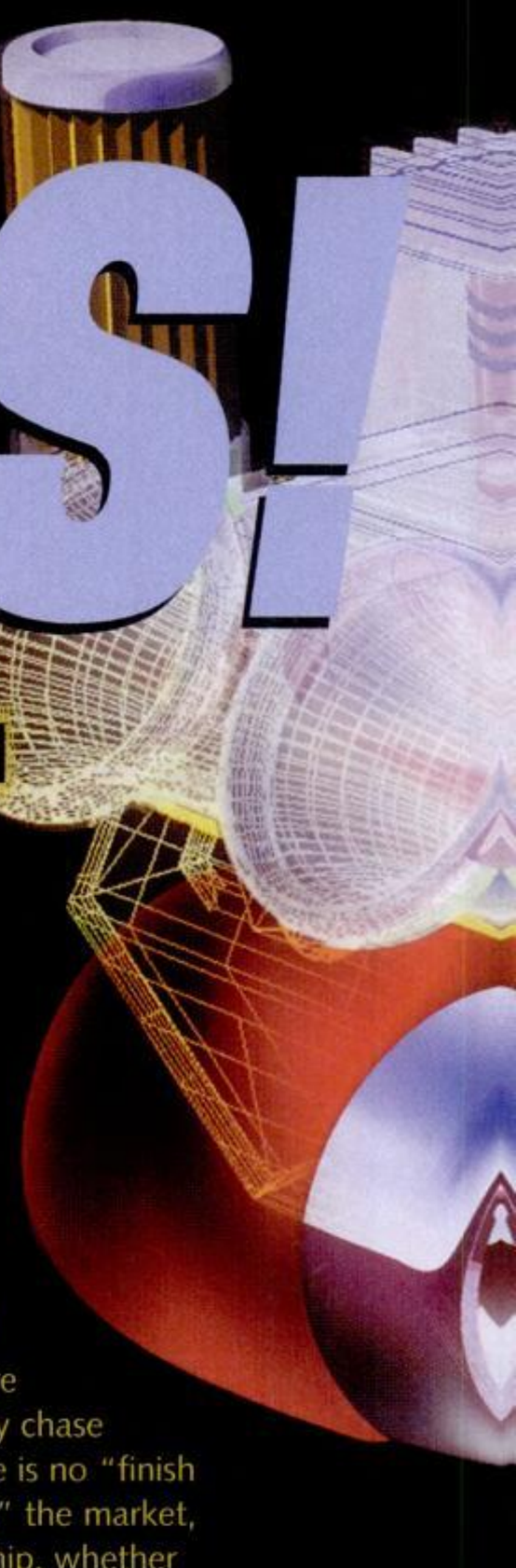
GENTLEMEN, START your ENGINES!



Thomas L. McDonald

If you were among the first to ante up for a GeForce-based videocard, you're probably wondering whether your early-adopter mindset will ever pay off. After all, most of the card's power remains untapped by even the most demanding games.

Buck up—the gap between software and hardware is closing. We've taken a peek at the next two years' worth of 3D-gaming software, and we can tell you that you're going to want the hottest hardware your wallet can muster. The next generation of 3D-gaming engines is playing for keeps.

A 3D-gaming engine is a set of code that tells the computer what to draw on screen. It describes how the vertice points of polygon models will be constantly recalculated to draw characters and scenery, and how visual effects such as multi-texturing will be rendered for maximum speed and visual splendor. The visual qualities enabled by the engine inform, to some extent, how a game will look and how fast it runs. Creating an engine is so massive an undertaking—and the finished results are so complex—that it would be a time and money nightmare to create a new engine for every new game. As a result, developers often license an engine that's already been created and wrap their own visual interpretation around it.

Confused? Consider this car analogy: In the late 1990s, BMW built a number of remarkably different-looking cars around a single 3.2-liter, straight-six engine. All the cars were high-performance sports vehicles that shared a common engine, but they had totally different ride qualities and body styles. The cars' uniform engine *informed* the way the cars looked and performed but didn't unconditionally *define* the way the cars looked and performed. Same goes for a 3D-gaming engine: Many games employ the *Quake II* engine, but each of these games has its own idiosyncratic look and feel. The developers of these games adorned the basic *Quake II* engine with unique modeling and texturing to offer a completely new gaming experience.

As game developers get hold of new videocard technologies—such as the GeForce line's hardware T&L—they must decide to either delay a game in order to stock it with a new engine that supports the latest and greatest technologies, or release the game immediately even though it won't take full advantage of many peoples' latest hardware purchases. Developers can never win if they chase technology, for the simple reason that there is no "finish line." New hardware is always "just hitting" the market, and at some point, a game simply has to ship, whether it takes advantage of T&L or not.

But for once, we're about to enter a stage where hardware and software are in a dead heat—where game engines have been written specifically to take advantage of what the current hardware can do. For the most part, that means recognizing that 3D cards are now capable of taking on many tasks once delegated to the CPU. As nVidia's Lloyd Case points out, "All 3D graphics manipulate geometry, then reduce it to a 2D image that's displayed on your screen. You can do this on the CPU or on a GPU [3D chip]. If you have a GPU capable of handling all the transform

CONTINUED ON PAGE 44

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

ILLUSTRATION BY RON MCPHERSON

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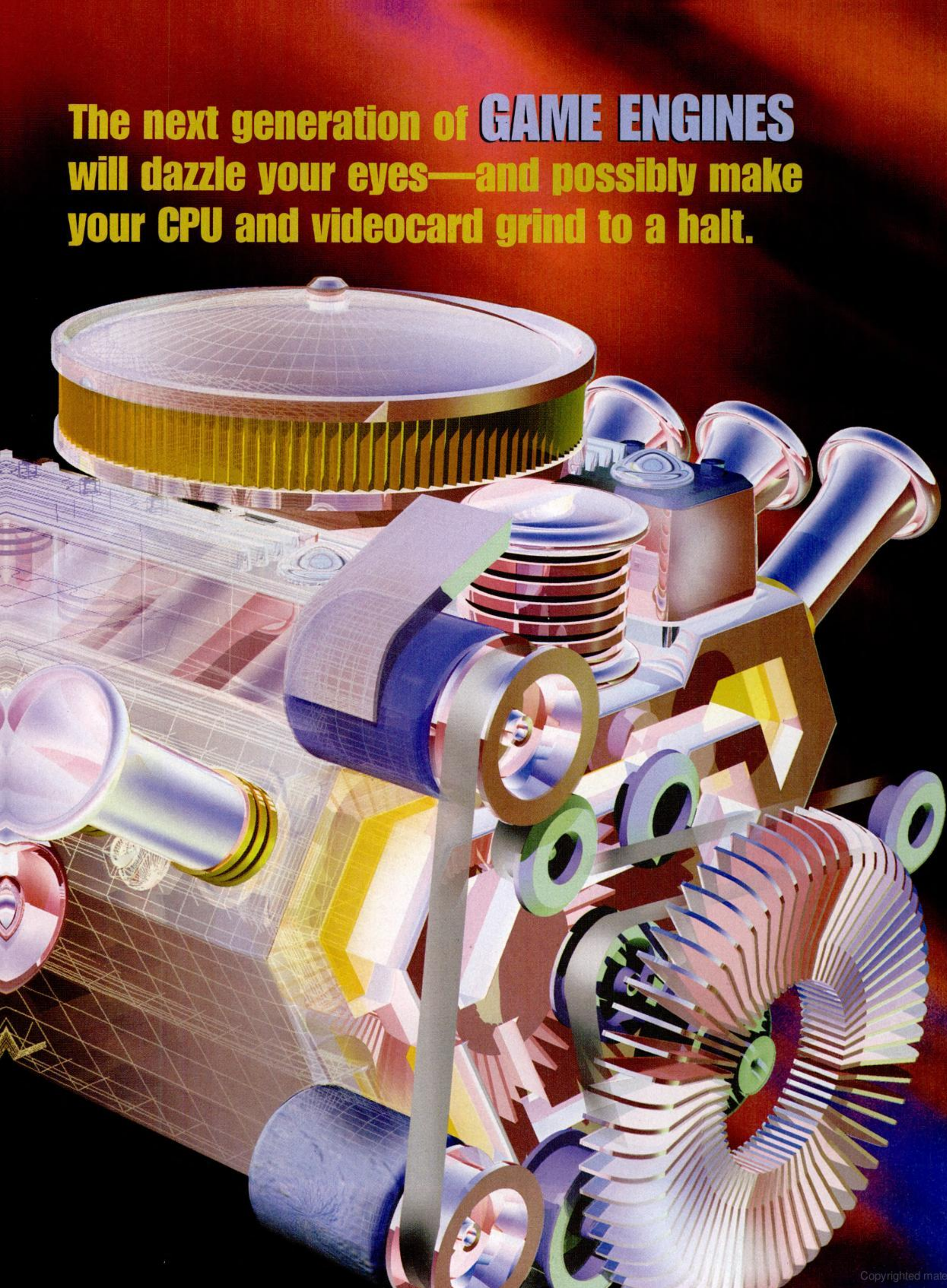
The next generation of GAME ENGINES will dazzle your eyes—and possibly make your CPU and videocard grind to a halt.



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and lighting calculations, then the CPU is free to handle more intensive AI, collision detection, pathfinding, audio, and any other task. Also, the GPU is much faster at manipulating geometry than the CPU, so you can have more geometric detail in a game title." What does this *mean* for games? Realtime, high-polygon-count scenes with rates of 31 million triangles per second.

We're finally starting to see some of the visuals that have been promised for the last year by hardware vendors, and they look nothing short of phenomenal.

REALLY UNREAL

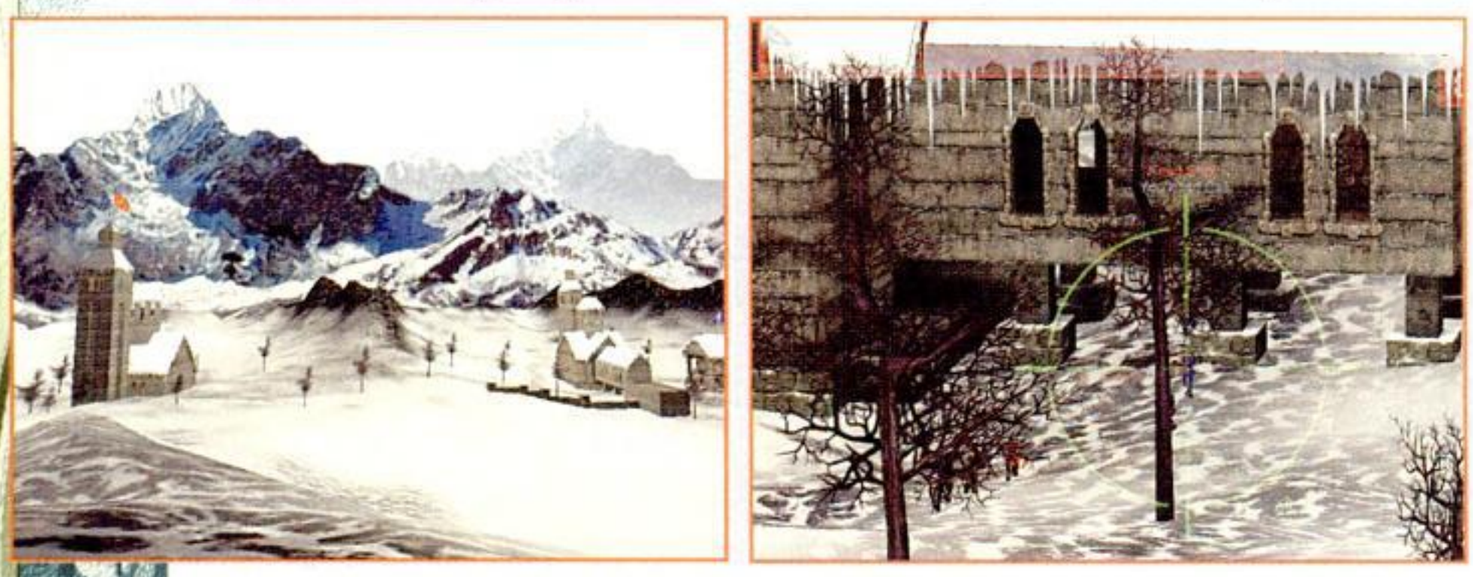
For the past few years, only two 3D engines have really mattered: *Quake* and *Unreal*. Both have undergone several mutations at the hands of their masters and other developers, producing an astonishing array of diverse results. Recall, though, that development on both began before decent 3D cards existed. By contrast, upcoming engines—including new iterations of these two—are being developed from the ground up for hardware that was just a pipe dream two years ago.

"Though we were one of the first 3Dfx supporters," says *Unreal* creator Tim Sweeney. "Software rendering was important to us in games up to *Unreal Tournament*. Now, we can start looking at GeForces and NV20s as the 'baseline' hardware for our next game. We're really focusing on taking advantage of the hardware 100 percent. For example, T&L will enable rendering of large-scale outdoor environments in our next engine. But things will get really exciting with the release of the first DirectX 8 hardware from nVidia and others. With programmable pixel shaders and vertex shaders at their disposal, game developers will be able to customize every aspect of a game's look and feel—especially animation and realistic lighting."

Unreal itself has already entered the next generation, and its jaw-dropping tech demo promises some unbelievable elements. High polygon counts are the new rule at Epic, with levels showing 100 times the detail found in *Unreal Tournament*, and object models comprised of up to 3,700 polys—that's about five times more detailed than those found in the original *UT*. A new skeletal modeling system, which you can see at work in the PS2 port of *UT*, adds 40 bones to the face alone, creating exceptionally fine facial expressions. Muscles, lips, eyebrows, teeth, eyes, and even hair have been given structure, so they can be individually animated.

Epic is also exploring the incorporation of facial motion-capture. According to skeletal animation programmer Erik De Neve, "The skeletal animation system allows for both loss-less and lossy compression of the motion data. The engine's rendering pipeline is being modified so that characters can be processed through the hardware T&L pipeline of Direct3D cards with that feature. That means the theoretical limit for polygons—and, more importantly, the number of characters onscreen—jumps substantially for applications intended for Microsoft XBox or computers equipped with hardware T&L-capable cards. In particular, the new features of DirectX 8 will enable skeletal characters to make full use of the hardware, accelerating rendering of smooth-skinned meshes."

So, when do we get to see all this in play? No word yet, though we know *Unreal II* is in the works.



With nearly 100 times the detail of the original *Unreal*, the next generation of *Unreal* technology shows an amazing leap in visual splendor.

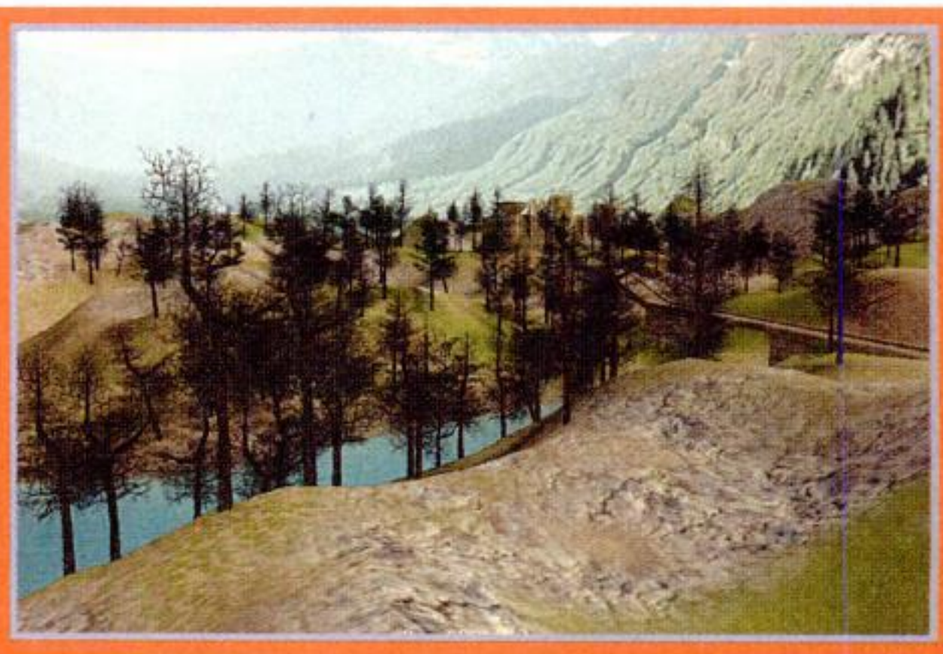
QUAKE GOES ON

Like *Unreal*, *Quake II* and *Quake III* have been wildly revamped, recoded, and reinvented by outside developers. The *Quake II* code given to Valve was rewritten so radically, it was almost

UNREAL ESTATE

The terrain system gracing the new *Unreal* engine is going to be a humdinger, according to Epic programmer Jack Porter:

"This particular terrain has around 128,000 polygons, with the entire scene weighing in at nearly 170,000 polygons. It's rendered using the hardware-transform capabilities of the nVidia GeForce 256. There are six layers in this scene, including rock, grass, dirt, a mottled grass/rock layer, and a shadow layer. The use of layers and the alpha maps allows the level designer to create a detailed terrain environment without any obvious texture-tiling artifacts."



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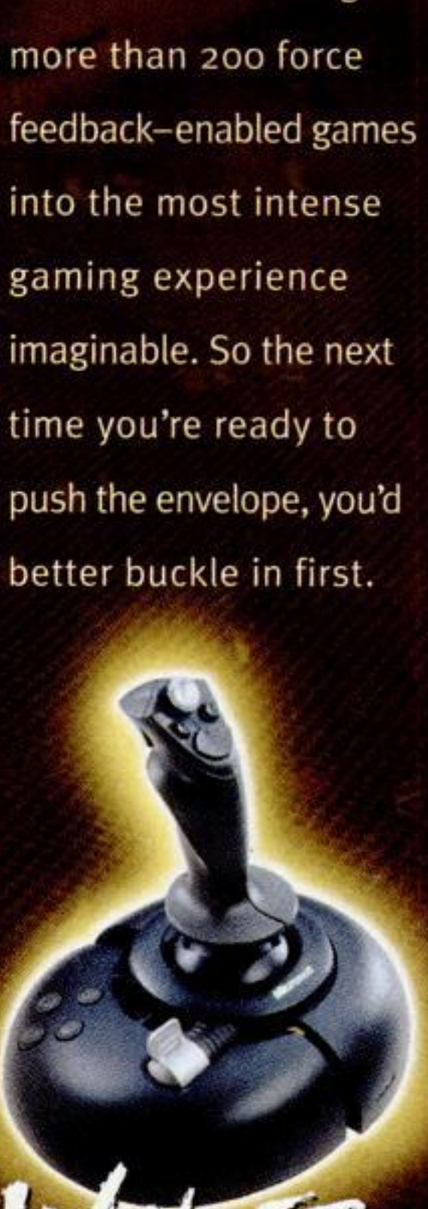

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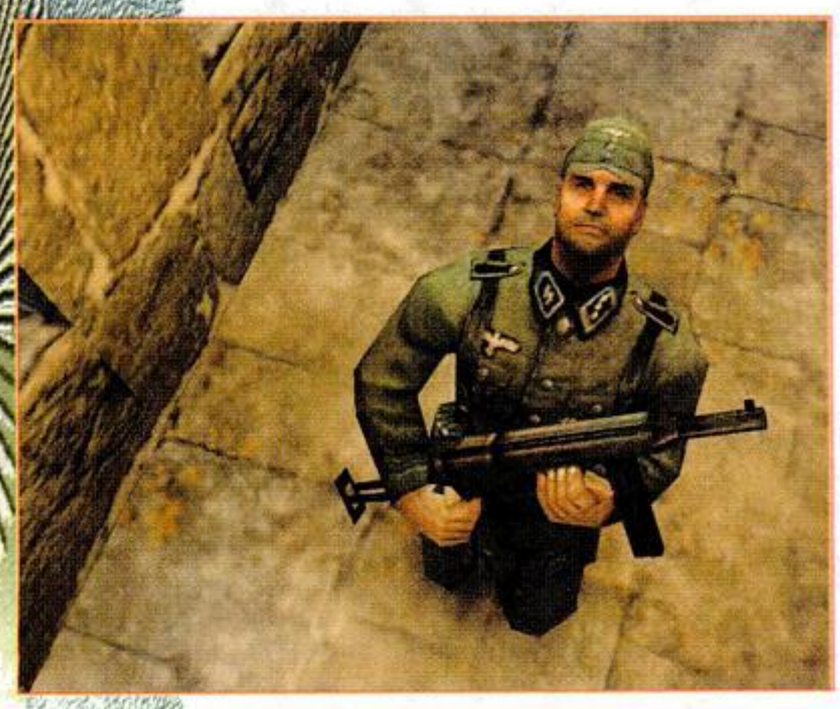
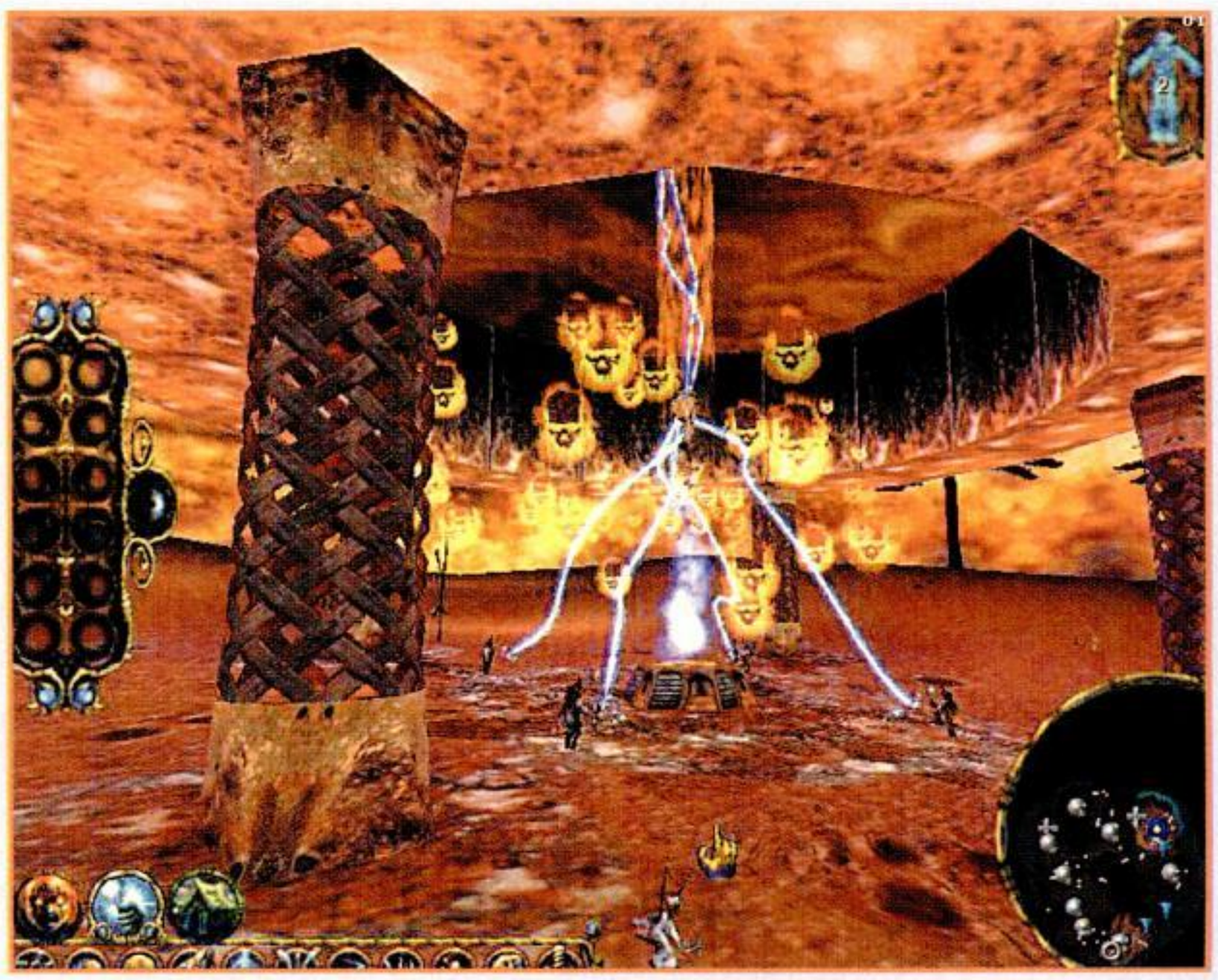
unrecognizable when it emerged as *Half-Life*. A game that's now positively Paleolithic by current 3D-engine standards, *Half-Life* was designed to run on a Pentium 133 without mandatory hardware acceleration. The models created for the Dreamcast version of the game have twice the polygons and more complex skins and skeletons than those found in the PC version, yet still use the same core *Quake* technology. This is a perfect example of the flexibility of John Carmack's engines, which have long lives because they can be scaled upward by third-party developers looking to take advantage of newer, faster hardware.

Quake III-engine games are just now starting to hit store shelves—which just goes to show how far a talented third party can push those bezier curves. *Quake* games have always been somewhat drab and, well, *brown*, but the games based on their engines have struck out in all sorts of startling directions, as seen in the wild colors of *F.A.K.K. 2*, *Alice*, and *Return to Castle Wolfenstein*. *Wolfenstein* even boasts textures based on digital photographs of German castles and towns. And all *QIII* licensees are adding a true skeletal system, in which "bones" underpin a multi-part model. A continuous mesh is laid atop the bones, eliminating the joint seams that are visible in traditional multi-part models (such as those found in *Quake III*) and allowing for more fluid, natural-looking movement.

There's a media blackout surrounding id Sofware's next major project—a game bearing the *Doom* name, possibly *Doom III*—so we can tell you precious little about it. We do know that the next engine isn't being created from scratch. As id programmer Jim Dose explained in a recent posting to Stomped (**www.stomped.com**), "The engine is being completely rewritten, piece-by-piece. The renderer, shader system, and game code are completely new. The cgame and network code have been removed. The animation system is currently being written from the ground up. The sound system and UI are still in place, but will be rewritten. At some point along the way, John will probably write a new network system. So, even though we're not starting out with a blank sheet of paper, the final result will be a full rewrite."



Activision used a heavily modified *Quake III* engine, complete with skeletal system, to create *Return to Castle Wolfenstein*.



One of the tougher things to get right in *Sacrifice* was "the hole"—the gamer's ability to **cut a hole through the world itself.**

SHINY SURFACES

Shiny Entertainment has staked out its own little corner of the 3D-gaming world with a string of system-straining engines. *MDK*, *Messiah*, and the recently released *Sacrifice* all demonstrate the efforts of a company pushing PCs as far as they can go. Demonstrating the most recent incarnation of Shiny's "scalable" technology, *Sacrifice* is the only game out now that will really light a fire under a high-end 3D card.

And just what is scalable technology? Nothing if not aptly named. Simply put, every model in the *Sacrifice* world is scalable with a continuous level of detail. Anything from a blade of grass to a large monster to the landscape itself can be scaled in terms of detail and complexity, providing the best frame rates for your particular system config. The engine "reads" your system specs, then adjusts detail on the fly to maintain user-customizable frame rates. Games usually scale for detail by providing several models of diminishing complexity, but in Shiny's engine, each object is created with a single model that can be drawn with any number of polygons between 200 and 2,500. The result is higher frame rates and smoother detail shifts.

"There are four different types of graphics-scaling in *Sacrifice*," programmer Martin Brownlow says. "First, there's the *Messiah* 'character' engine, which is used on all creatures and wizards. This is exactly the same code that was used in *Messiah*. Second, there's our own proprietary MRM [multi-resolution mesh] technology that was developed for *Sacrifice*. It uses a start mesh and takes polygons away one at a time, to form less-detailed models. Third is the landscape system, which uses something called a binary triangle tree combined with heavy-use-of-variance maps to remove detail as distance increases. Finally, there are all the parametric surfaces. Many spell effects use parametric surfaces, such as projected bezier curves, which are sometimes five-dimensional."

Brownlow attributes *Sacrifice*'s

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Shiny pushes current hardware farther than any other software with its new game *Sacrifice*, which is already being prepped for third-party developers.

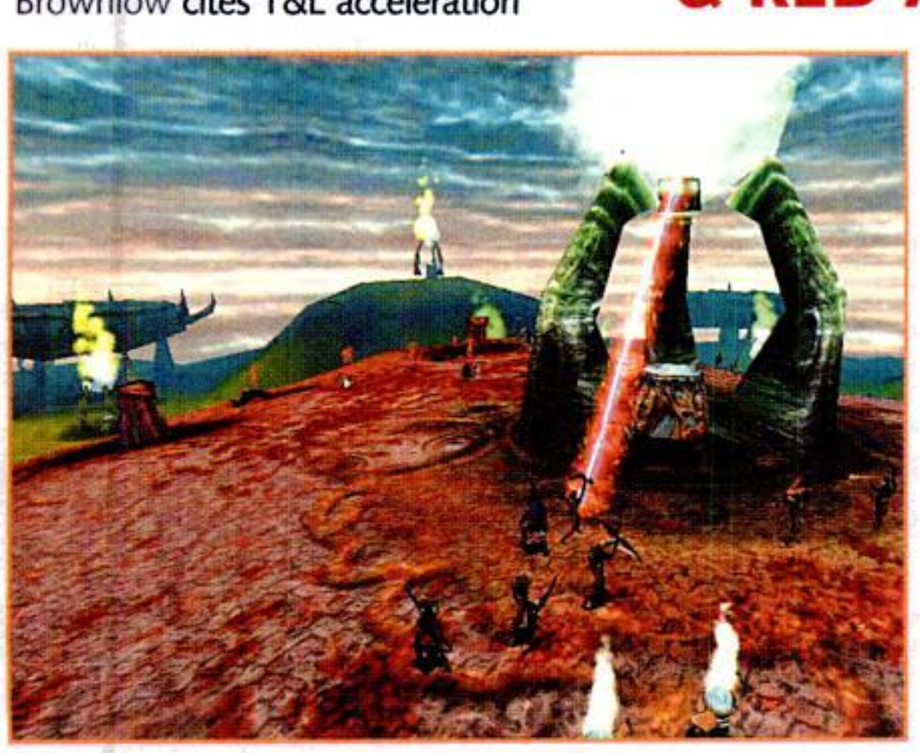
unique look to "widgets—little models that are scattered liberally around the landscape to add volume. They usually take the form of blades of grass, flowers, or rocks. Each has a constant position and orientation. If you move away from an object and come back, it will be in the same place with the same facing. There can be an almost unlimited number of widgets in a level." The result? A landscape made of many tiny models, rather than of huge texture swaths.

Shiny has always put a great deal of effort into making games that work well on older systems while still pushing hardware to its limits. In *Sacrifice*, Shiny coded multiple paths through the renderer, so graphics look the best they can based on the user's videocard.

Like the rest of the industry, Brownlow cites T&L acceleration as the best thing to happen to 3D graphics in the past year. It took the Shiny team a few weeks to almost completely rewrite the rendering code in order to take advantage of hardware T&L, but Brownlow says it was worth it. Why?

"More polygons, more rendering passes, more models. I think it's taking game makers a long time to embrace [T&L] because you can't easily write code that takes advantage of it *and* runs on older cards, unless you make two or three different detail levels for all of your content. That balloons the length of the already lengthy development process. But you'll see this improving as the bar for the lower end of machines is slowly raised."

BLACK & WHITE & RED ALL OVER



***Sacrifice* keeps frame rates high by continually adjusting poly counts in response to each user's system performance.**

Over the past few years, so many release dates have come and gone for perennial trade show favorite *Black & White* that adding another seems cruel. However, unlike other long-delayed projects, *Black & White* has gotten noticeably better each time it's been shown. This isn't a project struggling toward completion—rather, it's one that's milking every bit of potential from its design and, more importantly, from its engine.

Designed by *Populous* creator Peter Molyneux, *Black & White* is a category-busting, free-ranging, 3D god game in which you rule a land, "grow" a giant pet Titan, and fight with other sorcerers for dominance of the game world. A fine level of detail and immersion sets it apart: Characters have unique expressions, the environment is hyper-deformable, and the game even draws from your real-world environment by naming characters with names found in your e-mail address book and keying the game weather to the current weather outside your window.

There's no doubt that the *Black & White* engine is a mind-blowing concoction; its novel use of textures and morphing pushes 3D into several new areas. Early on, the development team considered and discarded a traditional "tiling" approach (using repeating texture maps laid out like tiles), due to the dynamic nature of the game world. The need to seamlessly morph the landscape as the game progresses requires something far more innovative.

Programmer Alex Evans observes, "We dynamically re-create the textures as you move around the world. This means we can apply unique detail, blending together numerous artist-drawn textures at any one point, so that the number of permutations is virtually infinite. We carefully stitch together elements from the buildings and other features sitting on the ground, so that streams, gardens, scorch marks, shadows, and snow all seamlessly blend into the surface of the ground. The most wonderful part about this system is that objects and people really look like they're *part* of the land, not just stuck onto it."

This approach has enabled the game's designers to create detailed locations that constantly change—a technique that also extends to the creatures, who change and age with the game. A cut on a monster will yield dribbling blood, a healing wound, and then a permanent scar. The major creatures boast between 1,000 and 2,000 polygons apiece; the little people range from 300 to 800 polys each. If that doesn't sound like a lot by today's standards, remember that this is a strategy

***Black & White*'s vast terrains, all of which can warp and evolve as the game unfolds, are created with a unique texture-morphing system, enabling continuous, seamless, evolving landscapes.**

game—100 of these models could be onscreen at any given time.

The *B&W* engine is capable of maintaining high per-frame polygon counts for a strategy game, easily pushing 20,000 polys around in a busy scene—and that's without repeated textures or lots of fully-skinned characters. The spell effects use many layers of transparent polygons to give the illusion of light volumes, pushing fill rates on even the GeForce2, which Evans calls "the highest fill rate card available."

"We use its T&L functions where available," says Evans. "At present this doesn't yield much improvement, because most people with T&L have extremely fast main processors anyway. We use environment and reflection mapping on some objects, as well as high-detail light- and shadow-maps inside the Citadel. We've put some pretty hi-res lightmaps into the Citadel, with some multipass texturing, to get some nice effects.

"Bump-mapping will be implemented for cards that support it, time permitting," he adds. "But, despite what card manufacturers say, bump-mapping is *not* the main way we get *B&W*'s unique organic feel. We use many 'simple' polygons, sometimes drawn in multiple passes, but are very careful about what we put on them—animated textures, calculated coordinates, or whatever—because we want to give it a look that most people don't expect." The team also made the ballsy decision to use skeletal animation for *all* of *B&W*'s animated characters.

A strong high-level animation system adjusts animations for each character and each character permutation, so as a monster grows and his shape changes, so does his gait. None of the animation is canned—it all scales and adjusts, like the rest of the system. This enables creatures to throw and catch objects, for example.

If Evans and fellow programmer Jean Claude Cottier were striving just to make *Black & White* look as good as possible, it would have been enough for most games. But with a design seeking to advance the genre to the next level, good looks weren't enough. What *Black & White* delivers is a truly evolving world in which you can affect the very appearance of a character—right down to his custom-designed tattoos—and move through a landscape that morphs to reflect the way you play. The unique nature of the game may mean that the *Black & White* engine will never be licensed out, but it's certain to produce a game we'll play for a long time.

***Black & White* uses a skeletal modeling system on everything from the largest Titans to the smallest villagers.**

THE EUROPEAN EQUATION

Strange 3D doings are afoot in Europe, and some of the results are quite advanced indeed. Croteam's *Serious Sam*, for example, comes from Croatia and has grabbed gamers' attention with its terrific-looking demo. There are definite rough spots—particularly visible in the occasionally crude models—but lead programmer Alen Ladavac is justifiably enthusiastic about *Sam's* largess of unique elements: "Realistic rendering with bright and live colors and large open spaces, instead of the modern trend of 'dark and moody' atmosphere in small rooms and corridors. Large masses of enemies, objects, and projectiles, all onscreen at once. Special lighting, and lens-flare and particle effects. Advanced six-degrees-of-freedom physics with multiple gravities." Hardware T&L support hasn't yet been implemented, but it's currently in the works.

Particle Systems returns with a new engine called Flux for the sequel to its classic space combat **game, *Independence War.***

At the 1997 E3 trade show, the press was blown away by a demo for Particle Systems' *Independence War*. Aside from the long-dead *Prey*, the *Independence* engine was among the most impressive that year, according to Particle's Michael Powell. "The game itself lived up to this promise, and now it looks like *Independence War 2* will recapture

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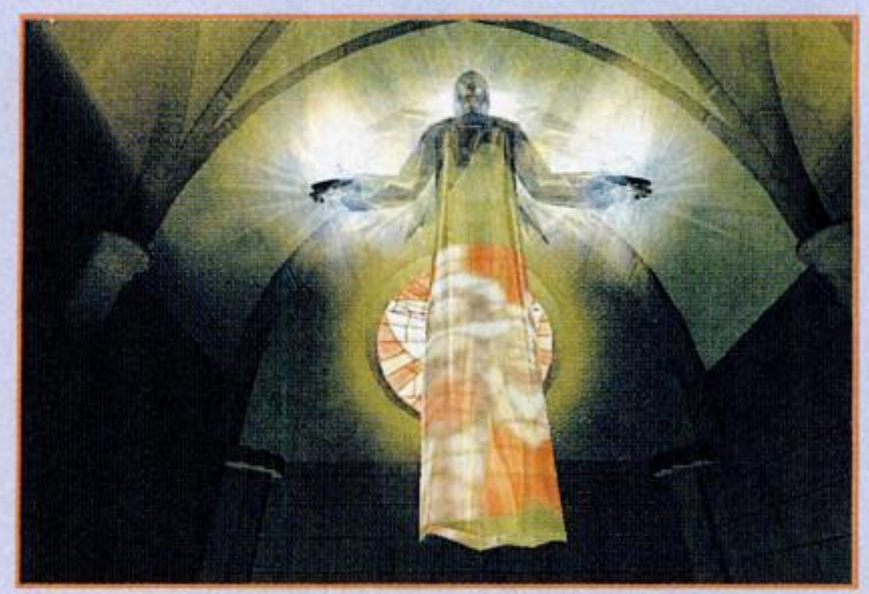


The FUN Labs' *Gothic Chapel* demo shows hardware T&L, per-pixel shading, and texture compression at work with GeForce2.

that magic with a whole new engine, dubbed Flux. In terms of features, we have full support for Direct3D and take advantage of new hardware features such as texture compression and accelerated T&L. The ship models have between 500 and 2,000 polygons. When you add several of these, along with environmental effects, missile trails, explosions, plasma beams, and planets, there can easily be 25,000 polygons in a single frame."

Two other notable European developers, Crytek and FUN Labs, remain a bit cagey about their current projects, but the tech demos (find them at **www.nvidia.com/demos**) are awesome, demonstrating that groundwork is being laid for some remarkable 3D engines. In fact, nVidia is using these demos to tout the powers of its board.

Romania-based FUN Labs is in development on a game called *Daemons*, and has recently signed a publishing deal with Activision for FUN's *Gothic Chapel* demo, which uses T&L, per-pixel shading, and texture compression. German company Crytek, meanwhile, is hard at work on its CryENGINE, which can be seen to startling effect in the tech demo for the squad-based first-person shooter *X-Isle*. Vast, smooth outdoor areas and curved surfaces with shader support highlight CryENGINE, along with hierarchical skeletal animation and vertex morphing. But what's most striking about *X-Isle* is its use of cube-mapping in transparent and reflection modes. The effects produced are akin to the liquid effects from the movies *The Abyss* and *Terminator* , but in realtime. These are simply stunning effects from a 3D engine. We can only hope that the game will live up to its good looks.

THE RACE CONTINUES

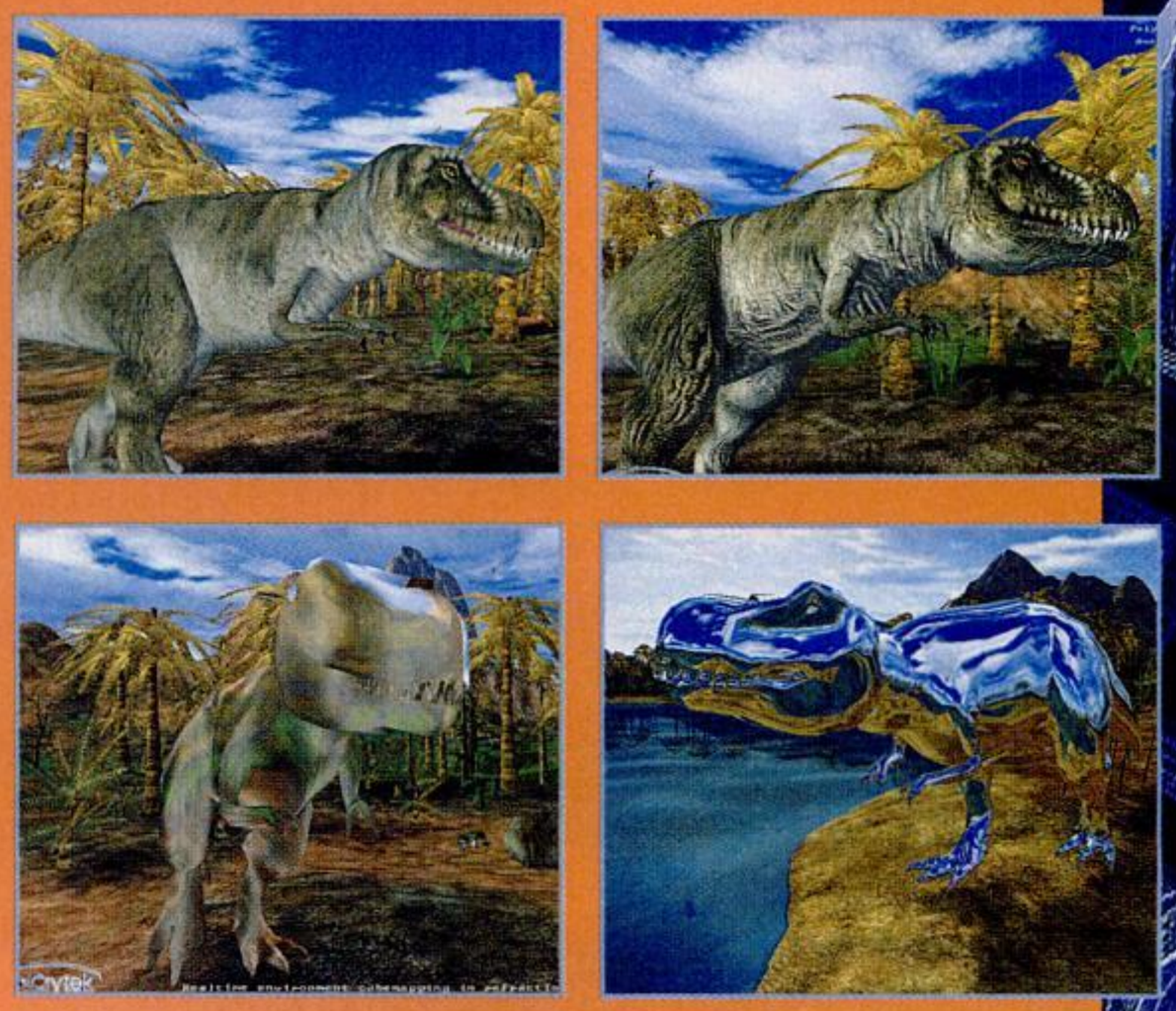
These are the techniques and tricks being used to milk the best possible visuals from the current generation of hardware. Software will continue to lag somewhat behind hardware, but the trend in development is clear: Make the videocards shoulder the workload and make the pipelines run faster. Of all the new features we've seen, per-pixel shading will have the most impact. It uses texels as a component in a lighting equation, rather than achieving effects by multitexturing. Per-pixel shading essentially takes lighting and shading down to the smallest components, enabling finer control and realistic effects such as wood grain and water ripples. This can all be done with today's technology, but developers have to write code that uses it, and we're just starting to see what that could mean in demos such as *X-Isle*.

As for the next step in hardware, Martin Brownlow of Shiny dreams of "a floating-point frame-buffer, with some user-defined function [clipping or normalization] applied to each pixel before it's displayed. Using this, you could simulate really bright lights by normalizing the frame-buffer with respect to the brightest color as it gets displayed, meaning really bright colors will be displayed at max brightness, and all other colors will be dimmed slightly to keep everything looking correct."

Of course, we're still waiting to tap the power of the hardware we have—and that leaves quite a lot to look forward to. ✹

THE CRYENGINE AND NVIDIA

Crytek created a self-running, in-engine demo of its CryENGINE technology, as seen in its forthcoming game *X-Isle*, to show the power of some advanced effects capable with the GeForce2. On the upper left you see a basic textured T-Rex with vertex lighting; to its right is a T-Rex that uses bump-mapping for skin texture and per-pixel lighting for added detail. Underneath this are examples of cube mapping, which creates refracted (left) and reflected (right) surfaces using the T-Rex shape.



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MINUSES

Bullies all other mid-market machines in the Lab

You complained. You shrieked. "Twelve grand for a single machine! You're friggin' nuts!"

Indeed, many readers thought the price tag for Dream Machine 2000 was excessive. While our first inclination was to tell our critics to "zip it," we eventually decided to feed their hunger for an accessible configuration. So we went back to the drawing board to build a "Mini-Dream Machine" for one-fifth the cost. It's everything Dream Machine is—only smaller, lighter, and much less expensive. And illustrating just how quickly PC technology evolves, Mini-Dream Machine is damned near as fast as our $12,000 monstrosity.

With only $2,500 to play with, we had to make several compromises to bring Mini-Dream in under budget. For starters, we eschewed the mantra of "clock speed at any cost." At press time, AMD's Thunderbird Athlon stood as the clock speed champion, but we skipped over the fastest 1.2GHz T-bird in favor of the 1GHz version. For our motherboard selection, we opted for the relatively inexpensive MSI K7T Pro board. If we had our druthers, we'd go for the Asus A7V for its onboard ATA/100 support and clean PCB layout, but it cost almost $50 bucks more. We also would've liked to have DDR memory, but at press time, no DDR motherboards were on sale. That was an evil development—but not in that "good evil" way in which most evil developments typically pan out.

Unlike Dream Machine 2000, Mini-Dream Machine embraces IDE RAID. So we hired Promise's FastTrack 100 RAID controller and a pair of 45GB IBM Deskstar hard drives. That gave us 90GB of storage, burst rates of about 89MB/sec, and average read speeds of 38MB/sec. Take that, SCSI RAID!

Everyone knows nVidia's GeForce2 Ultra is the fastest videocard in the solar system. It's also one of the priciest at $500. So we opted for the next best thing, ATI's 64MB Radeon. It's faster than GeForce2 at high resolutions and supports both video-in and -out.

By spending less money on the CPU and videocard, we were able to parlay our savings into some top-end equipment, namely TDK's 12/10/32 VeloCD burner and a Pioneer 16X DVD-ROM drive. For optical storage and reading, it's a combination that can't be beat. We passed on a DVD decoder because both the soundcard and videocard come with a DVD player. In the audio department, we substituted the familiar Sound Blaster Live! for Philips' new Acoustic Edge 5.1 soundcard, but stuck with the Klipsch ProMedia speakers for their subsonic warfare thump.

Our case selection might prove controversial. We originally wanted Cooler Master's ATC-200 but couldn't justify the $300 price tag. So we went for InWin's Q500. It's mundane but practical and includes a generous portion of drive bays and a removable motherboard tray. To aid in cooling, we added two high-velocity fans. You may also think us foolish, but we tossed the stock 250-watt power supply that came with our Q500 in favor of a 350-watt power supply from PC Power and Cooling. You might argue that the $100 could have been better spent on performance upgrades. We say nay. Plus, we wanted to make the point that you shouldn't skimp on your power supply. Got it?

So how does Mini-Dream perform? It's not the fastest gaming rig in this age of DDR Athlon systems and 1.5GHz Pentium 4 boxes, but it'll hold its own. It's also competitive with some Kick Ass-rated Athlon systems that have blown through the Lab recently. For $2,500, we don't think you can build a better system right now.

now, zip it! zzzpt... zzzpt... zip it!

under the hood

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RAM	256MB PC133 SDRAM (1.5GB max)
Motherboard	MSI K7TPro
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I/O ports	Five USB I Two serial I One parallel
DISPLAY	
Video	ATI 64MB DDR Radeon
STORAGE	
Hard drive	Two 45GB IBM 75GXP ATA/100
DVD	16X Pioneer 115
CD-RW	TDK VeloCD 12/10/32
Removable	3.5-inch floppy
NETWORKING	
Fax/modem	3Com NIC 3C905B
SOUND	
Soundcard	Philips Acoustic Edge
Speakers	Klipsch ProMedia
THE BUNDLE	
Microsoft Windows 98 Second Edition I Cyberlink *PowerDVD* I *Nero 5.0* I *MusicMatch* I *TDK Digital MixMaster*	

BOOT 0:59 DOWN 0:06

TEST	ZERO	MINI-ME	RESULTS (%)	RANK
SYSmark	174	191	9.7	Unseeded
Hard drive	20.2MB/sec	38.25	89.3	Unseeded
CD-ROM	26x	30x	15.3	Unseeded
Photoshop	170sec	126sec	25.8	Unseeded
Direct3D	38fps	68.5fps	80.2	Unseeded
OpenGL	34.4fps	69.6fps	102.3+	Unseeded

Full benchmarking details at **www.maximumpc.com/benchmarking/index.html**.

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Memory	256MB PC133 CAS2	$200
Keyboard	Microsoft Natural Pro	$50
Graphics card	64MB ATI Radeon	$275
Soundcard	Philips Acoustic Edge	$100
NIC	3Com 10/100NIC	$25
Hard drive	IBM 45GB	$180
Hard drive	IBM 45GB	$180
Power supply	PC Power and Cooling 350	$100
Mouse	Microsoft Intellimouse OEM	$15
DVD-ROM	Pioneer 115	$100
CD-burner	12/10/32 TDK	$300
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IDE RAID	Promise Fast Track 100	$110
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Begin the unnecessarily efficient cooling mechanism! They're really clones of Agilent's ArctiCooler, but the Chrome Orb fans do the job.

Better than so-called "lasers." ATI's 64MB Radeon videocard offers great performance and costs nowhere near... *one million dollars.*

An evil soundcard, perhaps? The diabolical Philips Acoustic Edge offers both Dolby Digital 5.1 and quad-surround support.

This organization will not tolerate failure! To protect ourselves against hard drive failures—and to make good on Dream Machine 2000's stillborn SCSI RAID configuration—we integrated IDE RAID into Mini-Dream.

Welcome to our underground lair. This time we cleaned up the wiring in our lair to make it sufficiently presentable for evil guests. Seriously, have you seen better?

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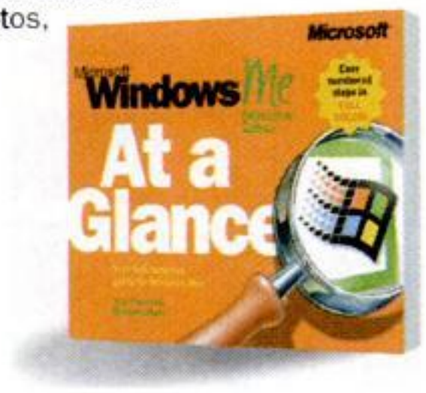

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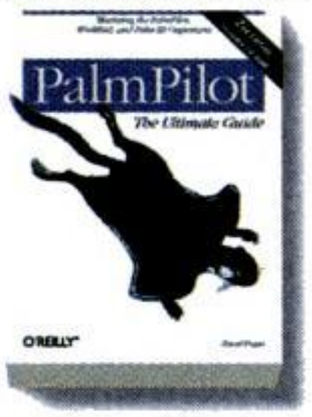

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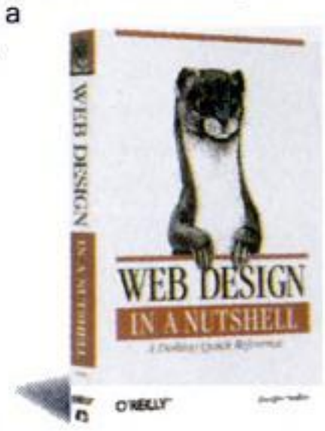

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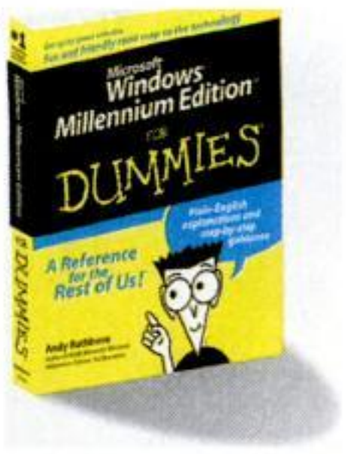

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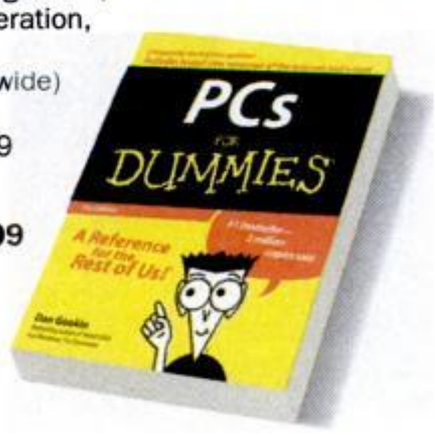

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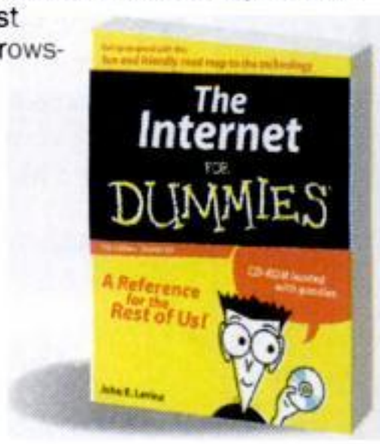

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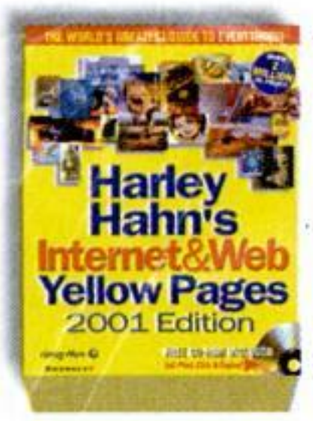

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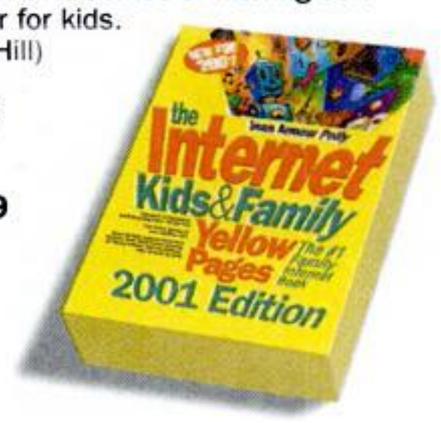

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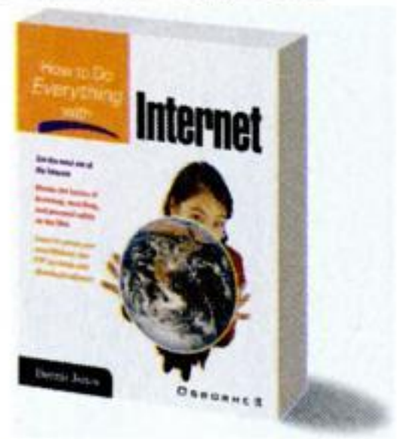

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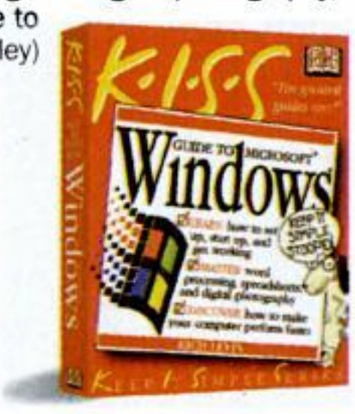

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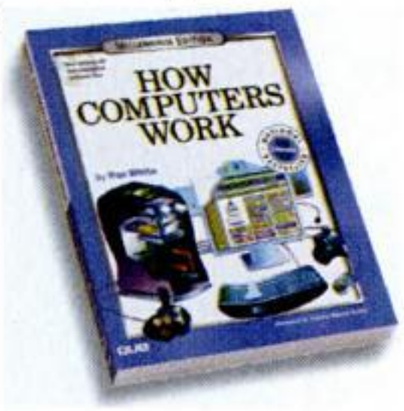

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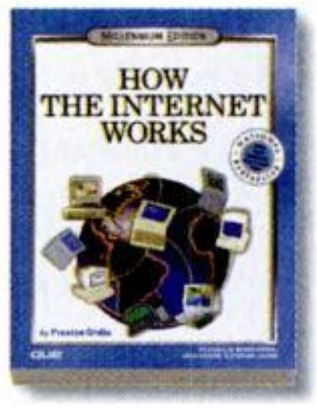

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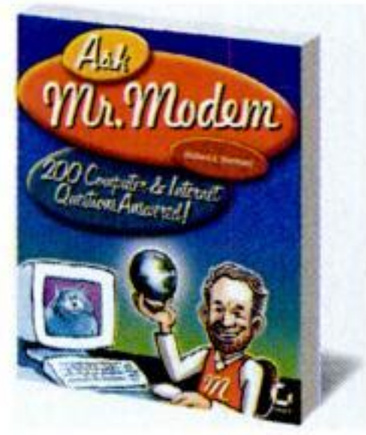

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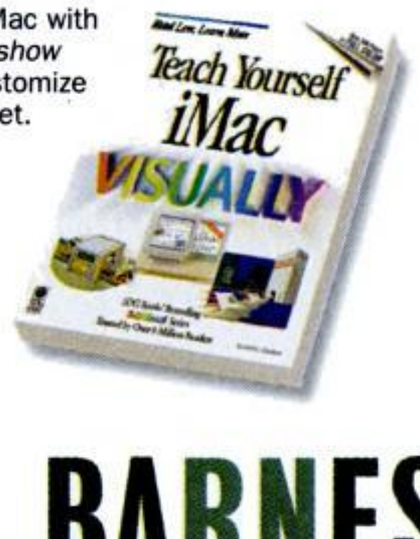

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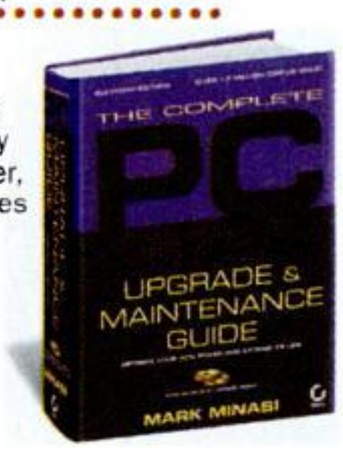

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BURN

Everyone's swaying to the sound of songs downloaded from Napster—and rushing to burn them to CD before the RIAA's lawyers crash the party. Among home users, there's unprecedented demand for CD-R/RW drives, and vendors of all stripes have stepped up to the plate with drives that offer lightning-fast recording speeds and generous software bundles. Of course, as any copyright lawyer will tell you, CD-RWs can hold more than just music. Looking to make "backup" copies of games and other software? Get yourself a burner, baby.

We take a look at the current state of CD-RW, including reviews of six new CD-RW drives—you'll find them on the following pages. We also give you the details on the differences between CD-R/RW media of varying colors, walk you through the process of making backup copies of software, and talk you through the current copyright laws regarding those copies. Finally, we take a peek at what's coming up on the CD-RW front. There's a lot to feast upon, so tuck your napkin into your shirt and try not to spill.

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BABY.

WHO NEEDS A CD-RW DRIVE? THE QUESTION IS, WHO DOESN'T? WE TELL YOU WHY YOU'VE GOTTA GET ONE, AND WHICH ONE YOU SHOULD BUY. JOSH NOREM LIGHTS YOUR FIRE.

The State of CD-RW

These days, the CD-RW market is dominated by one product—the 12x ATAPI drive. These drives can record at a peppy 1800K/sec and are significantly faster than the previous generation of 8x drives. In addition to the welcome 4x speed increase, many newer drives also boast a 10x rewritable speed—a major step up from the 4x rewrite speed that's been around for the greater part of the year. Those 10x rewrite speeds mean that packet writing on RW media—where data is written in small increments without session-closing overhead—is now officially an option.

When it comes to CD recording, SCSI has always been the superior technology because it's capable of command queuing, a process that involves organizing requests for data so they can be answered in the most efficient manner. The SCSI bus can handle up to 256 requests simultaneously, making it far more efficient for multitasking or for activities with a lot of back-and-forth communication between devices. In contrast, the ATAPI bus can handle just one request at a time and must block other requests until the original request is fulfilled. ATAPI also relies on the host CPU to negotiate communication between devices. Because of these limitations, ATAPI drives are far more problematic when it comes to burning CDs and are notorious for suffering buffer underruns. These underruns occur when the source—be it a hard drive or a CD-ROM—can't feed data to the CD-RW's buffer rapidly enough. When this happens, the laser stops, the disc turns into a useless coaster, and expletives are muttered under one's breath.

Goodbye, Buffer Underruns

Sanyo's patented Burn Proof technology may bring SCSI's reign over the CD-R world to a close. Where once the recording process was uninterruptible, Burn Proof allows the laser to stop writing if the buffer empties. While the laser takes a smoke break, the drive fills its buffer, locates the last-burned sector, and re-initiates the burning process. Make no mistake: Burn Proof is the new standard for Kick Ass CD-RW drives.

All six of the drives we tested in the torture chamber known as the *Maximum PC* Lab boast 12x recording speeds. Indeed, speed isn't going to be the differentiating factor between these drives. So why choose one over another? We considered two factors in particular: whether or not the drive employs buffer underrun technology, a.k.a. Burn Proof, and what software it's bundled with. A drive and its software need to work well together—if a drive is marketed as a "reliable backup solution," it better include an easy-to-use backup utility. If a drive boasts an extraordinarily fast audio extraction speed, it should come with robust extraction software and an MP3 encoding program. In fact, we think every CD-RW drive sold today should be bundled with MP3 encoding software, since MP3 encoding is the single most popular task currently handled by these drives. The notable exception is Sony—we don't ever expect to see a manufacturer with so many musical interests offer an encoder with its hardware.

BURN!

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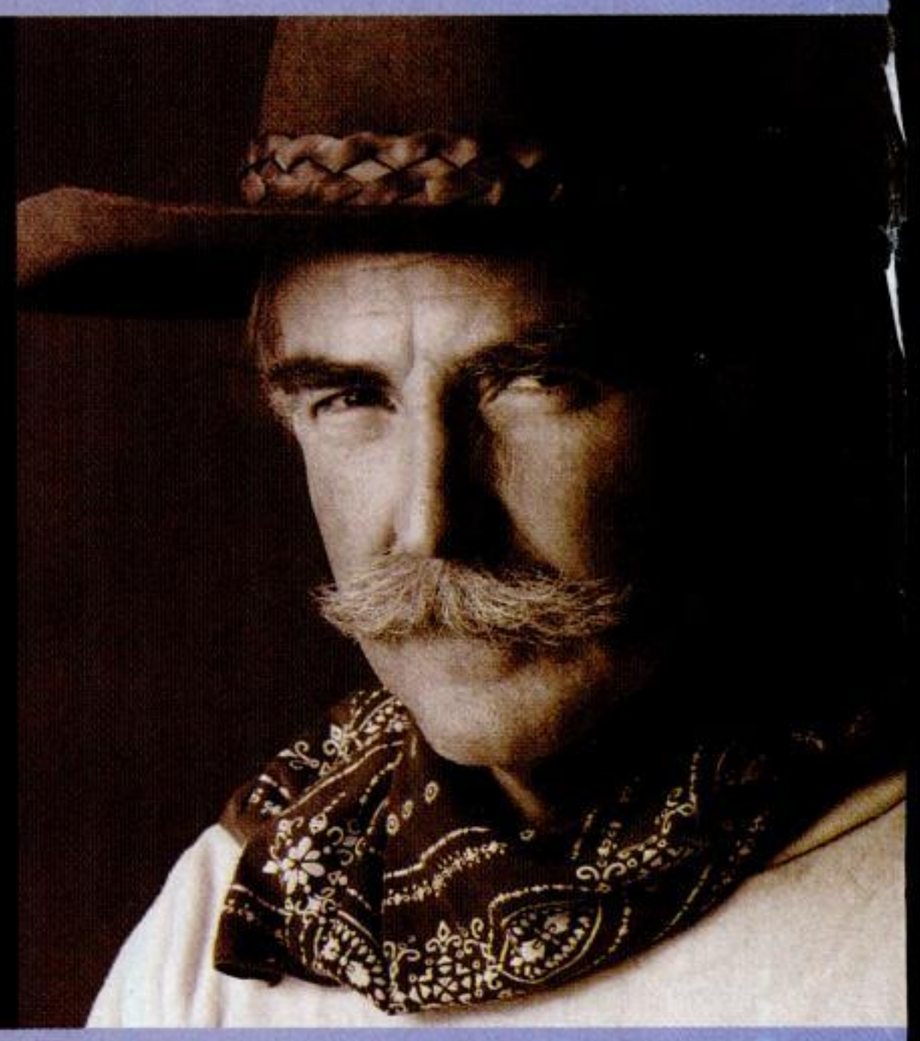
"Tell me again why I need a new Plextor drive — and smile when you say it."



Is it possible to make a product that's too good? At a recent trade show, we met a Texas rancher who bristled at the idea that it might be time to put his trustworthy Plextor® out to pasture.

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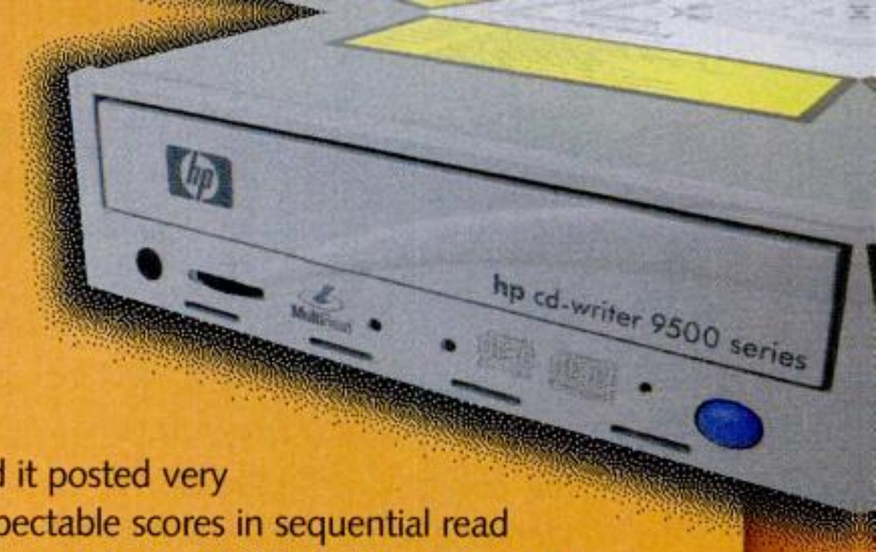
HP 9500i 12/8/32

THE EASIEST CD-RW TO USE, PERIOD



For the record: The 9500i is the CD-RW drive to buy if you've never used one before. Its software is idiot-proof, and the bundle includes an installation video, CD labels, and a handy online troubleshooting guide. Of course, being the jaded power-mongers we are, we don't personally like this sort of newbie stuff, but we're not so jaded that we can't see the value of HP's approach.

The 9500i's software is easy to use, but lacking in features.

The most significant addition to HP's CD-RW lineup is new software made by Veritas, which replaces Adaptec *Easy CD Creator* as the bundle's mainstay. Called *HP MyCD*, the software is so simple to use, a cocker spaniel could burn a CD with it. The main interface's four huge buttons correspond to such specific tasks as disc-to-disc copying and creating an audio CD. Once a button has been clicked, it generally takes just one step to burn a disc.

The software's simplicity comes at the cost of advanced options, however; the Veritas package is the most bare-bones of any CD-mastering package we've seen. Its sublime usability is great if you're a rank amateur looking primarily to make music and audio CDs, but you're screwed if you want to, say, copy games or overburn your media. Advanced options just aren't in the cards with this package.

The 9500i nips at the heels of the other drives in terms of benchmark performance, and it posted very respectable scores in sequential read tests, random and full-stroke access, and data CD creation. Unfortunately, it hangs with the loser crowd in audio tests. With a lackluster ripping speed of 12x—meaning it averages about 7x—the HP drive is passable for audio work, but is certainly not the fastest drive to be had. The drive also lacks Burn Proof technology. HP does bundle *MusicMatch Jukebox* with the 9500i, but it's a limited-use edition, which sucks.

MAXIMUM PC VERDICT 6

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Teac CDW512E 12/10/32

LOOKS ARE DECEIVING

The CDW512E may be the most boring CD-RW drive ever made. Its official name is "Teac CD-RW." Snazzy, huh? And its bezel is boring, too. But before your eyes glaze over, take a look at its random and full-stroke access times! Hel-lo, hot stuff! Are those things real? It doesn't seem possible, but somehow, the plain-Jane Teac drive posted access times roughly twice as fast as those of any other drive here. It ripped an unbelievable 74ms average random access time, compared to the 130-ish ms scores of most of the other drives here, and a 145ms full-stroke time, compared to the competition's 250ms average. Incredible.

The Teac boasts zippy access times and an all-Adaptec bundle.

The Teac also took top honors in audio extraction tests, thanks to its 24.9x maximum extraction speed. That's damn fast and puts the Teac drive in the same company as the TDK and Plextor drives when it comes to ripping duties (see pages 60 and 61). Extraction quality was also excellent.

In spite of the similarities, we could tell the Teac was cut from a different cloth than the Plextor and TDK drives when it couldn't make a functional game backup. It's possible the drive simply can't make backups, but it could aslo be the fault of *Easy CD Creator 4.0*, which is a superb application, but not the best for making dupes. Speaking of Adaptec, the Teac drive includes an all-Adaptec lineup, which we think seems rather uninspired when compared to the interesting packages bundled with other vendors' drives.

In the end, the Teac is a mixed bag. Its access times and extraction speeds are simply outstanding, but its status-quo software bundle and inability to successfully complete our game backup test is unfortunate. It also lacks Burn Proof technology, which puts it out of serious contention in this crowd.

MAXIMUM PC VERDICT 7

$300 | Teac
www.teac.com | 323.726.0303

GETTING TESTY

Our CD-RW tests are designed to measure synthetic and real-world performance. Here's a quick look at what each test measures.

Sequential read tests These measure how fast a drive can read data that's stored on a disk sequentially, as opposed to reading data from random parts of the disk. Since drives read more data from the outer edges of a disc, sequential read speed is tested at nine different disk locations in order to obtain an average across the entire disc.

Random and full-stroke access tests These show how long it takes a drive's pickup assembly (where the laser is) to access a random sector on a disc. Full-stroke access times measure the longest a drive would ever take to access data.

Creating a mixed-mode CD Most game CDs are mixed-mode—they contain one large data track and several audio tracks. We test how quickly the drive can copy a mixed-mode CD.

Digital audio extraction Not all CD-ROMs and CD-R drives can read audio data, but when they can, the process is called digital audio extraction. We test whether or not a drive is capable of doing this, how quickly it can do it, and the audio quality of the resulting disc.

80-minute media This media offers 80 minutes of recording space per disk, as opposed to the original 74 minutes. A good drive will be able to read from and record to 80-minute media.

Overburning Overburning allows you to write more data on a disk than is normally permitted. Not all drives or software packages support this process.

Packet writing This allows data to be written piecemeal onto a disc, without any overhead such as creating a table of contents or organizing the data. Packet writing allows drive-letter access to a blank CD-R/RW, so you can drag-and-drop files onto a blank disc.

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Ricoh MP7120A 12/10/32

RRRRRRRRICOH, SUAVE...

Ricoh's 12x CD-R/RW drive earns big points for its ease of use and outstanding scores in several benchmark categories, but it ultimately comes up short with a lackluster software bundle and poky extraction speeds.

The Ricoh took first-place honors in both data CD creation and RW disc creation, and was even able to make a functional copy of our test game, *Kingpin: Life of Crime*. (After testing, the backup copy was incinerated, per the request of Imagine Media's Corporate Counsel.)

Prassi's *PrimoCD* offers an easy-to-use wizard, as well as an extremely complex "power user" interface, which has features-a-plenty.

For sequential reads and access speeds, the Ricoh drive was just a tick behind the fastest drive in the group, and its 4MB buffer and S/PDIF port for digital audio (provided your soundcard accepts such an input) mean it can certainly keep up with the Joneses' CD-RW drives in terms of features.

Where the Ricoh lags is in the software department. It includes only Prassi's *PrimoCD Plus* and *abCD* packet-writing software. At first we were blown away by the sheer speed and flexibility of the Prassi software, but when we moved on to audio testing, we were let down. The software doesn't look up audio track information from the Internet or perform on-the-fly decoding from CDA to WAV, so you have to extract files to WAV—which happens to be easy, thanks to an intuitive interface—and burn them onto a CD as Track1, Track2, etc. What a crock! At least the Ricoh drive can hit extraction rates of nearly 20x, placing it near the top of the pack when it comes to ripping audio. Audio extraction is simplified by the easy-to-use Prassi software, which makes extracting audio and creating ISO images a two-step process.

Still, the Ricoh failed to impress us overall. The Prassi software is feature-rich and easy to use, but its lack of Internet connectivity is a crying shame. And with only two software programs included in the bundle, the Ricoh drive has the skimpiest package of any drive in this roundup. Couple these shortcomings with a lack of Burn Proof and you can see why it's hard for us to recommend this drive at this time.

MAXIMUM PC VERDICT **7**

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www.richoh.com | 800.225.1899

Sony CRX160E-A1 12/8/32

GREAT SOFTWARE, DECENT HARDWARE

The Spressa CRX160E isn't the best drive in this roundup, but it's not the worst, either. The conspiracy theorists on staff think the CRX160E is actually the same drive as the HP 9500i, because the two achieved eerily similar benchmark scores in most categories (and because typically, HP buys drives from other vendors). Regardless, the Sony is a solid performer, held back only by its lack of Burn Proof support and a sluggish audio extraction rate.

Sony has the most original software bundle in this roundup, but its hardware is only mid-pack.

In most of our tests, the Sony ranked about mid-pack, but it performed impressively in random and full-stroke access tests. In fact, its access scores were so amazing, we began to think we had somehow erred in testing. To wit: The CRX160E's random access scores are nearly 50 ms below spec. *Below* spec, people! The drive's full-stroke times also whip the competition by 100 ms (the Teac drive notwithstanding), which is simply astonishing. It shows during plain-old access tests, too; the CRX160E drive practically responds to requests instantaneously. And fast access makes this drive a good CD-ROM drive replacement.

Interestingly, Sony markets the CRX160E primarily as an audio drive—which makes sense, given Sony's audio heritage. But Sony told us that, due to its position as a huge player in the recording industry, the company won't include MP3 encoding software with any of its drives. That in itself is a shame—but it becomes more curious when you consider that the CRX160E rips audio at about half the rate of some other drives in this roundup.

Again, the conspiracy theorists are all abuzz. Perhaps Sony is discouraging ripping altogether? Hmm...

Sony does include a copy of *Mixman Studio Pro* and throws in our top pick for backup software, Dantz's *Retrospect Backup Express*. These programs round out the package nicely and set the CRX160E apart from the other drives in this roundup.

MAXIMUM PC VERDICT **8**

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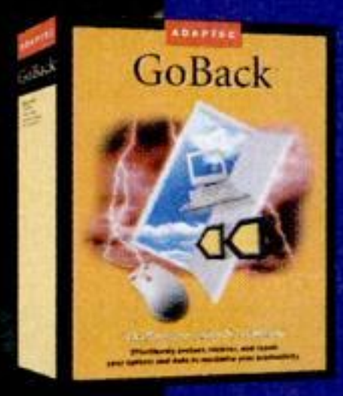

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Plextor PlexWriter 12/10/32A

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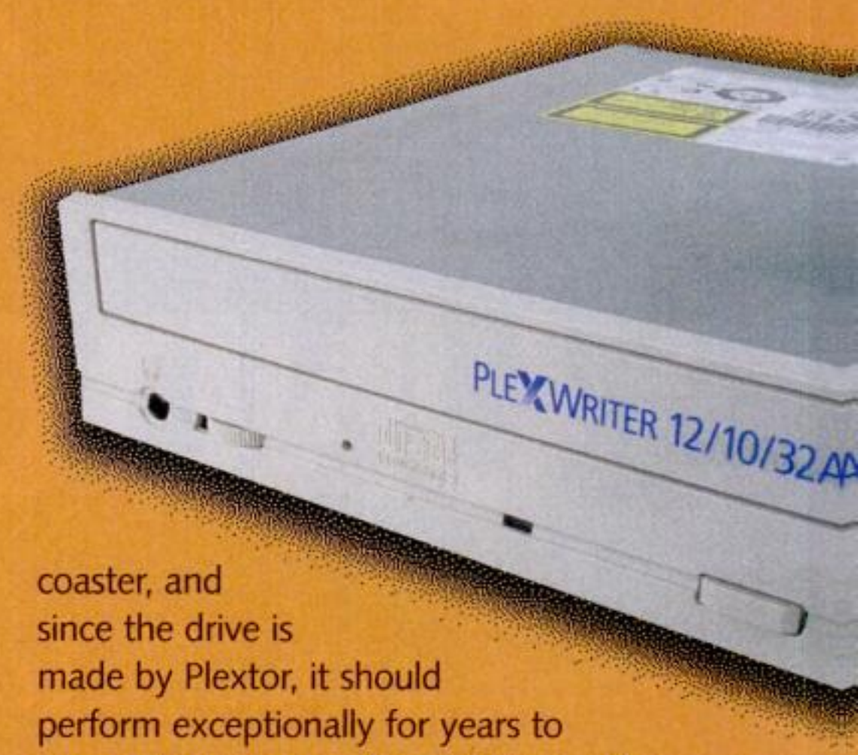


Plextor has always held a special place in our hearts for making the fastest, most reliable CD-RW drives on the planet, and the PlexWriter 12/10/32A is no exception. The PlexWriter's most distinguishing feature is its use of Sanyo's Burn Proof technology. This isn't a surprise inclusion, considering that Plextor has always led the way with next-gen features in its drives. As we've already stated, Burn Proof works like a charm, and the Plextor drive suffered no buffer underruns during testing.

Of the drives in this roundup, the PlexWriter's biggest competition is the TDK VeloCD. The two are evenly matched in terms of benchmark scores and features, but the VeloCD gains the narrowest of margins in the software category. Plextor hasn't changed its software bundle in eons, and its age is starting to show. The *Plextor Manager 2000* software enjoys some enhancements and firmware tweaks, but we think it's time for a total overhaul. The *AudioFS* program allows extraction to WAV and WMA, but not to MP3. The media player features clunky navigation and becomes your default MP3/WAV player whether you like it or not. In fact, the only major difference between the software bundle with this drive and the one that accompanied the last Plextor drive we reviewed (Plextor 8/4/32, April 00) is that *Easy CD Creator* has been upgraded to 4.0, and the *PlextorManager* software has undergone a few revs. It's a welcome upgrade for sure, but *PlextorManager* is getting a bit long in the tooth. We also missed the *CD-ResQ* backup utility, which apparently is only included with Plextor's SCSI drives.

Plextor's 12/10/32A rocks hard and offers Sanyo's Burn Proof technology and killer benchmark scores, to boot.

Software complaints aside, the PlexWriter is an incredibly strong offering from Plextor. Burn Proof technology practically ensures that you'll never burn a coaster, and since the drive is made by Plextor, it should perform exceptionally for years to come. Heck, it even does "raw" copying, which means it can copy everything on a disc—even bad sectors meant to derail duplication software—and boasts one of the fastest digital audio extraction rates in this roundup. It may not be a 100-percent perfect hardware/software marriage, but the 12x PlexWriter comes pretty damn close.

MAXIMUM PC VERDICT **9**

$330 | Plextor
www.plextor.com | 800.886.3935

Color Me Burnable

Silver disks? Green disks? Blue disks? What are the differences? And which color media is the right color to use?

The truth is, the best media for your CD-RW drive is the brand recommended by the manufacturer. Most people never even check to see which brands of media are recommended by their drive manufacturer and instead buy bulk spindles of junk media because the price is so good. Not surprisingly, they experience errors during recording, and eventually think they've bought an incompetent burner—which may not be the case. Low-quality media is responsible for at least as many coasters as slow source drives or multitasking have ever been.

The color of a piece of media is determined by the combination of colors used in the organic dye that composes the disc's recording layer and the reflective layer that sits on top of it. Just as in the Zip-Loc commercials, if a vendor uses blue dye and a yellow reflective surface (for example), the media will appear to be green. Most of the blue media that's popular today, howver, is the result of a blue dye appearing behind a silver reflective layer.

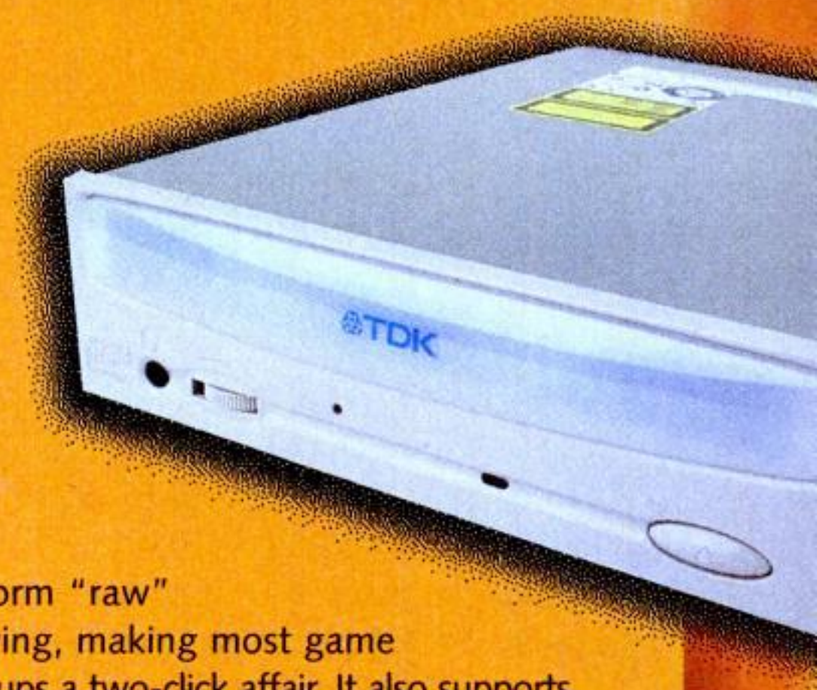
Currently, there are two different types of dye and two types of reflective layers. Cyanine dye is cyan blue in color, and phthalocyanine dye is virtually colorless. The two types of reflective layers are silver alloy and 24-karat gold. When you create all the possible color combinations of these different dyes and reflective layers, you come up with the various colors of CD-R media presently found on store shelves. All these colors and materials conform to the CD-R specification, which is dictated by the Orange Book specification for CD-WO, or CD Write-Once CDs (CD-R, basically).

Why the rainbow of flavors? Because different vendors have patented their respective processes and materials. It's hard to find details on the benefits and detriments of one color dye or reflective layer over another, and even harder to quantify in lab testing. The current standard is a silver reflective layer, which replaced its less-reflective predecessor, the gold layer. Gold discs are rumored to have better longevity than silver reflective layers, but that's purely conjecture.

So which color is best? We can't tell ya—because we don't know. The truth of the matter is, there are too many variables involved to state unequivocally which is best, and choosing a reputable vendor is more important than choosing a piece of media by color. Stick with the known brand names and you won't get burned.

TDK VeloCD 12/10/32

CD-BURNING NIRVANA



The TDK VeloCD is a dream come true for power users, offering a one-two punch of killer software *and* hardware. As its benchmark scores illutrate, the VeloCD is a top performer in almost every benchmark category—with the exception of full stroke access—and buries the competition in mixed-mode CD duplication tests to the tune of almost three minutes. The VeloCD also features Sanyo's Burn Proof technology; the VeloCD never suffered a buffer underrun, even when we copied 650MB to the hard drive while burning data from the same hard drive onto a CD on the fly.

TDK also includes a star-studded selection of software, including *Nero 5* for CD mastering and backup tasks; *MusicMatch Jukebox* for ripping MP3s; *TDK Digital Mixmaster* for disc duplication and audio CD creation; and *InCD* for packet-writing duties. At the risk of sounding like we're on the TDK payroll, the software selection is absolutely spot-on. The only complaint we can register is with the *Digital Mixmaster's* bizarre, "we're so cool" interface—an unwelcome holdover from the software's previous rev. The default skin for the player is utterly confusing, but fortunately there's a "standard" skin with an interface that's easier to understand. Still, it's nowhere near as easy to use as free programs like *Winamp*, but its saving grace is its awesome 20-band equalizer, which affords you total control over your music.

At the risk of sounding like we're on the TDK payroll, the software selection is absolutely spot-on.

Other highlights: The VeloCD can perform "raw" copying, making most game backups a two-click affair. It also supports such power-user features as overburning, packet writing, support for 80-minute media, and on-the-fly decoding of MP3s to WAV.

The VeloCD's only downside is its price—it's the most expensive drive in this roundup, ringing in at a hefty $350. However, when you consider the fact that this drive offers every next-gen feature and has arguably the best software of the lot, it's easy to see why it costs so much. As far as we're concerned, it's worth every penny.

MAXIMUM PC VERDICT **10**

$350 | TDK
www.tdk.com | 516.625.0100

DARE TO COMPARE	Plextor	TDK	Sony	HP	Teac	Ricoh
Model name	PlexWriter 12/10/32A	VeloCD 12/10/32	CRX160E-A1	CD-Writer 9500i	CDW512E	MP7120A
Buffer size	2MB	2MB	4MB	4MB	4MB	4MB
CD TACH						
Ave. sequential read (MB/sec)	**3.64**	**3.64**	3.54	3.59	3.57	3.27
Random access time (ms)	127	123	104	99	**74**	111
Full-stroke access time (ms)	273	274	171	157	**145**	194
Max CPU utilization	6%	6%	**5%**	**5%**	**5%**	**5%**
Drive rating	**21.9x**	**21.9x**	21.3x	21.6x	21.4x	19.6x
AUDIO EXTRACTION						
Max. extraction speed	24.5x	24.5x	12x	12x	**24.9x**	19.6x
Audio extraction using WinDAC	2:05	**2:01**	3:19	3:19	2:00	2:12
CD MASTERING						
Data CD creation	6:55	6:51	6:45	6:44	6:49	**6:37**
Mixed-mode CD duplication	9:33 (8x)	**6:49**	9:52 (10x)	17:35 (4x)	9:20 7:51 (audio disk)	9:10
Game backup successful?	yes	yes	yes	no	no	yes
Software	Adaptec *Easy CD Creator 4.0, Direct CD 3.0, Plextor Manager 2000*	*Nero 5, InCD Packet Writing, TDK Digital Mixman, MusicMatch Jukebox*	*CD Extreme, Sony abCD Packet Writing, Spressa Play & Record, Mixman Studio, Retrospect Express*	*HP MyCD, MusicMatch Jukebox, CD Labeler, HP Simple Backup*	*Easy CD Creator 4.0 d, Direct CD 3.0 d*	*Prassi PrimoCD Plus, abCD Packet Writing*

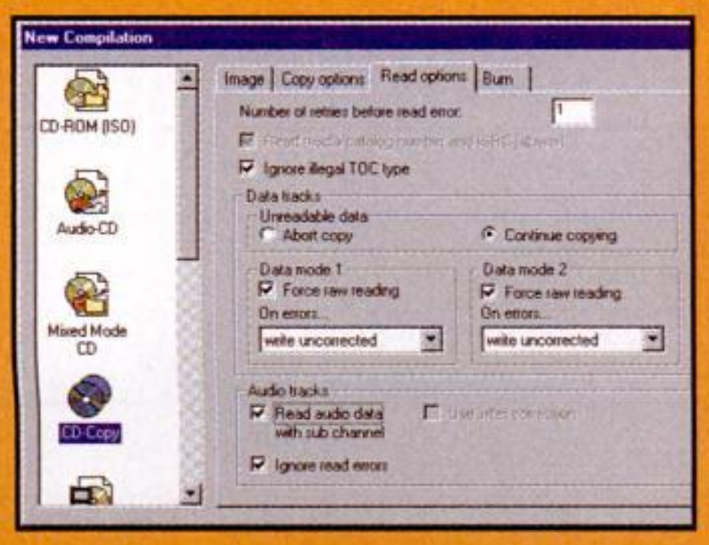
Copyrighted material

The Dark Art of Game Backups

Making backup copies of games and other software has always been tough—and it's going to get tougher, as developers hoping to protect their copyrights employ various forms of protection in hopes of foiling would-be backup mavens. Their tools include:

• **LASERLOCK:** One of the toughest forms of copyright protection to defeat. It's manufactured by MSI LaserLock International (**www.laserlock.com**) and works its magic by including a hidden directory on the CD that contains unreadable errors. When attempting to copy a disk that's protected with LaserLock, the source drive will encounter read errors and won't be able to continue the operation.

• **SAFEDISK:** This popular protection scheme, made by Macrovision (**www.macrovision.com**), consists of two parts: A digital signature that can't be copied and an encrypted wrapper that includes authentication instructions. From what we can deduce, SafeDisk splits up the authentication procedure into several files, each one requiring the others to function. None of them can be copied.



Ahead Software's *Nero* (www.ahead.de) can make exact copies of most disks, thanks to options such as "force raw reading" and "ignore illegal TOC type."

• **SECUROM:** This protection scheme (**www.securom.com**) created by Sony embeds a secure fingerprint onto a CD-ROM, labeling each disk with a unique identifying number. An authentication process included on the disk is able to identify a "genuine" CD, which requires the aforementioned identifying number.

• **ILLEGAL TABLE OF CONTENTS (TOC):** This simply involves arranging a table of contents on a disc in such a way that it produces read errors.

In spite of all these stopgap measures, you can create backups of your software, assuming your game's license agreement allows you to. Here's what you need:

• **HARDWARE:** You need a recorder that can copy and read in "raw" mode, meaning that it doesn't care if there's an unreadable file on a disk, because everything gets copied. The only two CD-RW drives we know of that advertise this feature are the TDK VeloCD and the Plextor PlexWriter, though we found the Sony CRX160E and the Teac drive were also capable of raw copying.

• **CLONE CD:** This illustrious program (**www.elaborate-bytes.com**) enables "raw" mode copying on any disc, whether it's copyright-protected or not. We've experimented with this program in the Lab, and, by golly, it actually works. Raw mode copying simply means everything is copied, including bad sectors or "illegal" tables of contents that foil disc duplication.

***Clone CD* can be used to override copyright protection, but its drive support is limited.**

• **COPYING FILES TO THE HARD DRIVE:** We've found that some software titles simply can't be copied in a disc-to-disc or disc-to-image fashion, but we've had moderate success by moving all the contents of a disk to a folder on the hard drive, then burning that folder to a disc.

• **GAMECOPYWORLD.COM:** The title of this web site pretty much speaks for itself. It offers a variety of downloadable "backup" measures, including "fixed" executables you can use to run games without the CD. More importantly, it provides information about copyright protection methods currently in use and ways to get around them, should you be so inclined. As long as you're not breaking any licensing agreements, feel free to consult this site as you see fit.

COPYRIGHT PROTECTION: WHAT'S THE LAW?

Whenever the merits of CD-RW drives are discussed, the practice of copying software inevitably comes up. Some folks will tell you that it's legal to make backup copies; other will swear it's against the law. What's the real deal? Well, it depends on the situation.

According to section 117 of the United States Copyright Act, it's perfectly legal for the owner of a software license to make a backup copy of a software title, with two stipulations. The first is that the backup copy must be intrinsic to the software, meaning that in order to even use the program in the first place, a backup copy must be made. (For the record, we have no idea what kind of software falls into this category.)

The second, and much more important point, is that if a backup copy is made, it must remain with the original owner at all times. So it's legal to make a backup copy of a software title, but it's illegal to sell the backup or transfer it to another person. And if you sell the original software title, you must also transfer the backup to the new owner.

So, it's always legal to make backups, right? Not quite. Section 117 can be superceded by a program's licensing

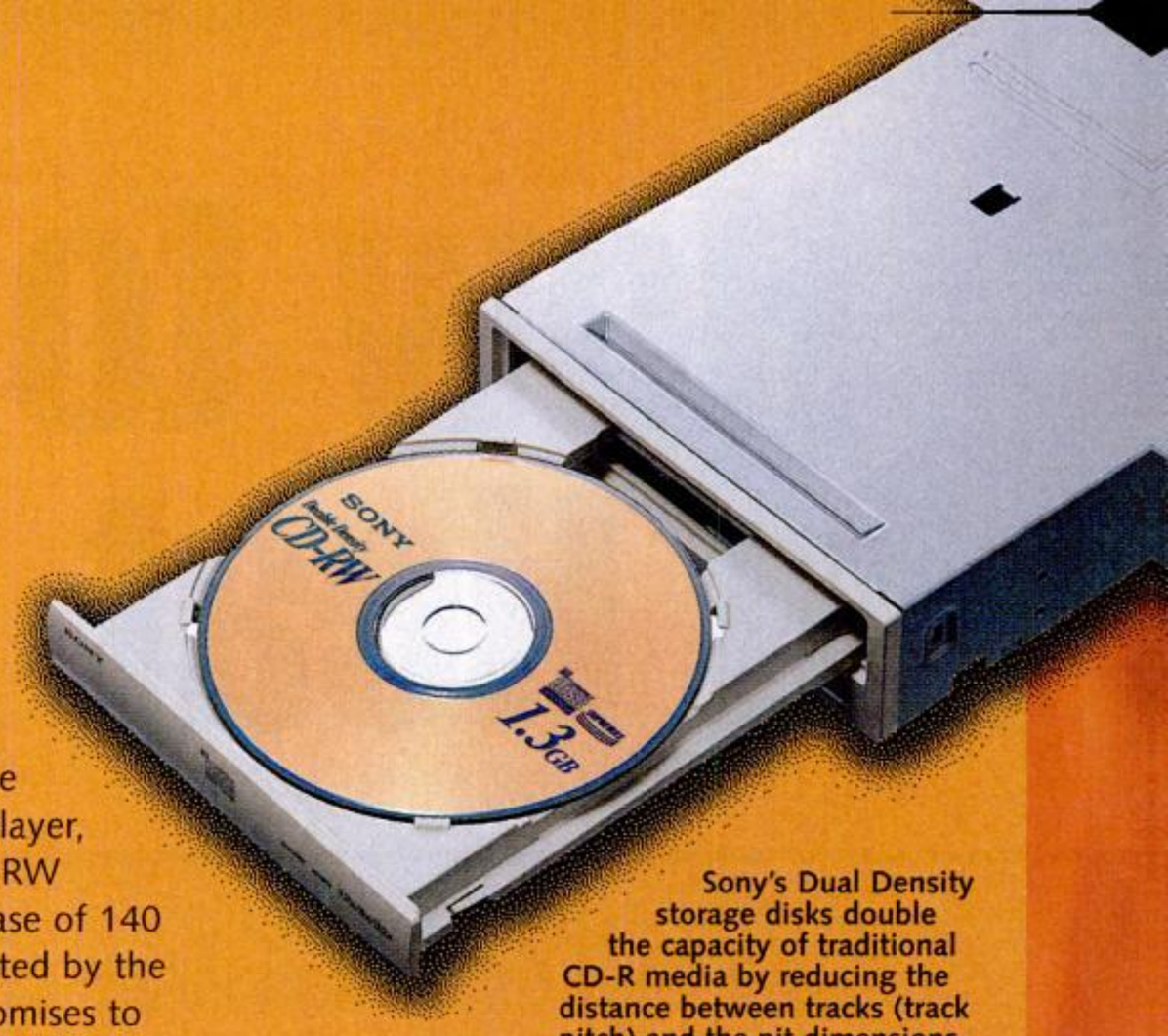
Copyrighted material

Upcoming Optical Technologies: Hot, hot, hot!

A gaze into the crystal ball of optical storage yields a view of some awesome emerging trends.

SONY DUAL DENSITY STORAGE: Storage yahoos may remember an announcement from Sony in the summer of 2000 claiming there was a way to get 1.3GB of data onto a standard 120mm Compact Disc. The technology isn't exactly revolutionary—it simply involves reducing the disc's track pitch (distance between tracks) and pit dimensions to achieve a higher bit density. The bad news is that data recorded on this 1.3GB "dual-density" media will only be playable in dual-density drives. However, dual-density drives are backward-compatible, so Sony hopes folks will jump on the train like they did when CD-RW drives hit the market.

DVD+RW: The 2001 release (HP swears that date is real) of DVD+RW drives, with a capacity of 4.7GB, will allow users to record onto DVD-RW media that can be played in any DVD video player, DVD-ROM drive, or DVD+RW player. Since an installed base of 140 million such drives is expected by the end of 2001, DVD+RW promises to be the most favorable medium for large capacity storage in the near future.



Sony's Dual Density storage disks double the capacity of traditional CD-R media by reducing the distance between tracks (track pitch) and the pit dimensions.

Constellation 3D's flourescent disc technology uses up to 10 layers of data per 120mm disc, with each layer capable of holding 1.4GB of data. The discs will likely be offered in a variety of fun colors, including transparent.

FLUORESCENT MULTI-LAYERED DISC (FMD): When Constellation 3D announced its fluorescent disc technology in early 2000, PC enthusiasts collectively wet themselves thinking about the prospects. Touting an initial storage capacity of—are you ready for this?—140GB per disk, this media ups the number of layers used to hold data from the current one layer per disk to a staggering 10 layers per disk. Constellation plans to release two products in 2001, including an FMD drive (initial disk capacity is undecided at this point), and a 5GB credit-card sized removable storage card that will function like Flash media. On paper, it sounds great. Whether or not Constellation can deliver the product—and whether it will gain widespread adoption—remains to be seen.

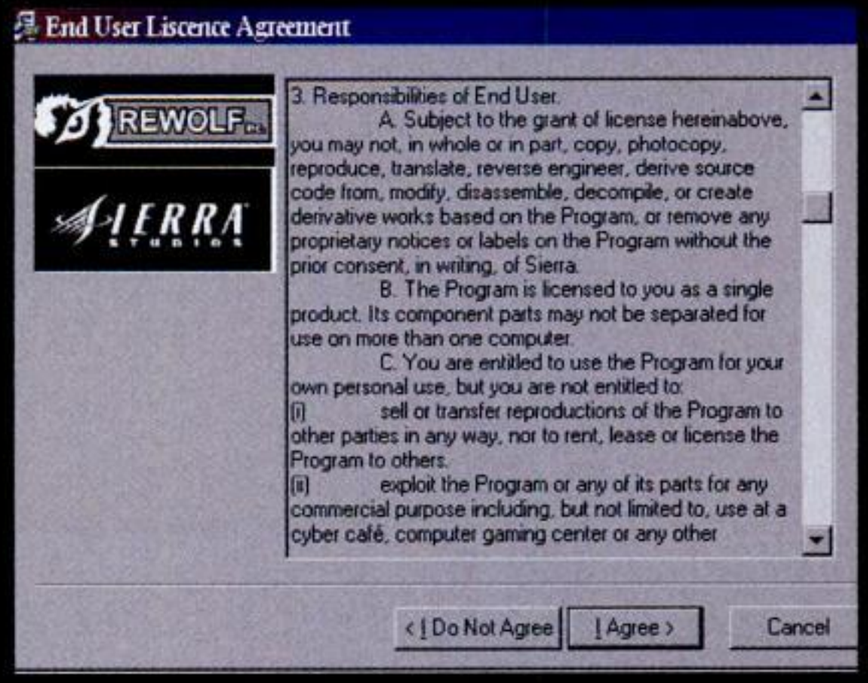
TDK MULTILEVEL RECORDING Media champ TDK has partnered with Calimetrics to deliver MultiLevel, a CD-recording technology that effectively triples the existing specs for CD-R. CD-R drives currently record at 12x; MultiLevel allows recording at 36x onto 2GB disks. Holy schnikes!

Rather than shrinking track pitch (like Sony is doing) or adding datatracks (like Constellation), MultiLevel technology uses a grayscale system instead of pits and valleys to represent the binary code, so varying shades of grey, white and black represent ones and zeroes. Overall, eight levels of gray are used to increase capacity and writing speeds threefold.

Like Sony's Dual Density disks, MultiLevel disks will only be compatible-with MultiLevel drives. But MultiLevel drives will be backward-compatible and able to function as standard 12x CD-RW drives. The true benefit of this technology, however, is that it can be applied to any optical recording strategy, so any manufacturers that license it can realize a tripling of performance for their current technology.

TDK says drives should appear in 2001, at a small premium above today's 12xCD-R-drive prices. ✹

agreement. For instance, according to Mike Kelly, Piracy Enforcement Manager for Eidos Software, the licensing agreement for all Eidos titles says personal backups are a no-no. So if you agree to Eidos' licensing agreement during a game's installation, you're promising not to make a backup copy of the game. Kelly says that individuals are free to call Eidos and request the right to make a backup, but that they're almost always summarily turned down. Special circumstances, such as a charity event, may warrant multiple backups, but Kelly says they handle such requests on a case-by-case basis. The next time you install software, read the licensing agreement to see if it gives you permission to make a backup.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REWOLF
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How to Build a Heat Pipe

With Your Own Homemade Cooling Contraption, You Can Have the Most Overclocked Proc on the Block.

Place one ungloved hand in the *Maximum PC* Lab, and your frozen digits will immediately tell you that we take climate control very seriously. Heat is the overclocker's enemy, and we do all we can to keep our precious components cool. Thus, the Lab temperature is set to "Antarctica." But keeping things cool outside the case is just the tip of the iceberg (pun intended).

We're always on the prowl for solutions that will chill our PCs' guts out. Heatsinks and fans are one option, but we decided to look for something better. Something that would give us an excuse to use a Bernz-O-Matic torch.

Behold, the heat pipe.

In the world of electronics cooling, heat pipes are a mainstay. Using basic physics, a heat pipe cools and object simply by transferring heat from one area to another.

The process is a relatively simple one: An evaporator is placed on a known "hot area"—in our case, the processor—and filled with a refrigerant that can absorb conducted heat. The heated refrigerant rises toward a cooling receptacle known as a condenser. Once there, the refrigerant is cooled by conduction and the resulting heat is dispersed out the rear of the case. The refrigerant then moves back down into the evaporator, and the process starts all over again.

Our theory is that a heat pipe that features a condenser located outside the system's case will expel virtually all of the heat produced by the system's overclocked processor. So, if our project works as planned, we should see an increase in the proc's overclockability.

We'll also protect other components—such as high-speed hard drives, RAM modules, and overclocked videocards—from the heat pockets created by the popular fan/heatsink combo, which can blow hot air to other regions of a case.

We can already see the gleam in your collective eye, so rather than keeping this project all to ourselves, we've provided you with detailed instructions for building a heat pipe of your own. It's cheaper than buying a faster proc, it gives you an excuse to solder something, and it earns you the right to be the first on your block to say, "Hell, yes! I cooled my hot proc with my own homemade contraption!"

Of course, we must remind you that even the iciest of cooling options won't rock a proc that, by nature, can't be overclocked. Not all processors are of the overclocking persuasion, so give yourself a fighting chance by building your heat pipe for an overclocking-friendly proc.

When choosing procs to overclock, consider the speed and position of the L2 cache, whether the cache is on-die or off-die (full-speed, on-die, L2 cache is best for overclocking purposes), and the die-manufacturing process (smaller is generally better).

The motherboard and RAM will also affect your system's overclocking potential. The mobo influences your frontside bus speed options and voltage settings, and the RAM must be able to withstand the frontside bus speed you've set, or your system will venture into lockup land.

We built a heat pipe to cool the following system, which we believe to be imminently overclockable: An unlocked 600MHz P-III proc coupled with 128MB of PC133 SDRAM crammed into an Iwill W02-R motherboard, with a Hercules 3DProphet II videocard thrown in for kicks. The whole thing is living in a SuperMicro 750a case that offers enough room to comfortably house the heat pipe apparatus.

On the following pages, you'll find an ingredients list and a step-by-step description of how to construct this monster. The materials cost about $175 total. The project should take about three hours if the word "brazing" means anything to you. If the term "soldering" rings a louder bell (as it does for most laymen), you've got a more significant project on your hands.

For the record, the refrigerant coursing through our heat pipe is good old-fashioned distilled water—you can't beat it when it comes to latent heat-bearing capacity, and it's easy on the pocketbook.

—Scott Tarr

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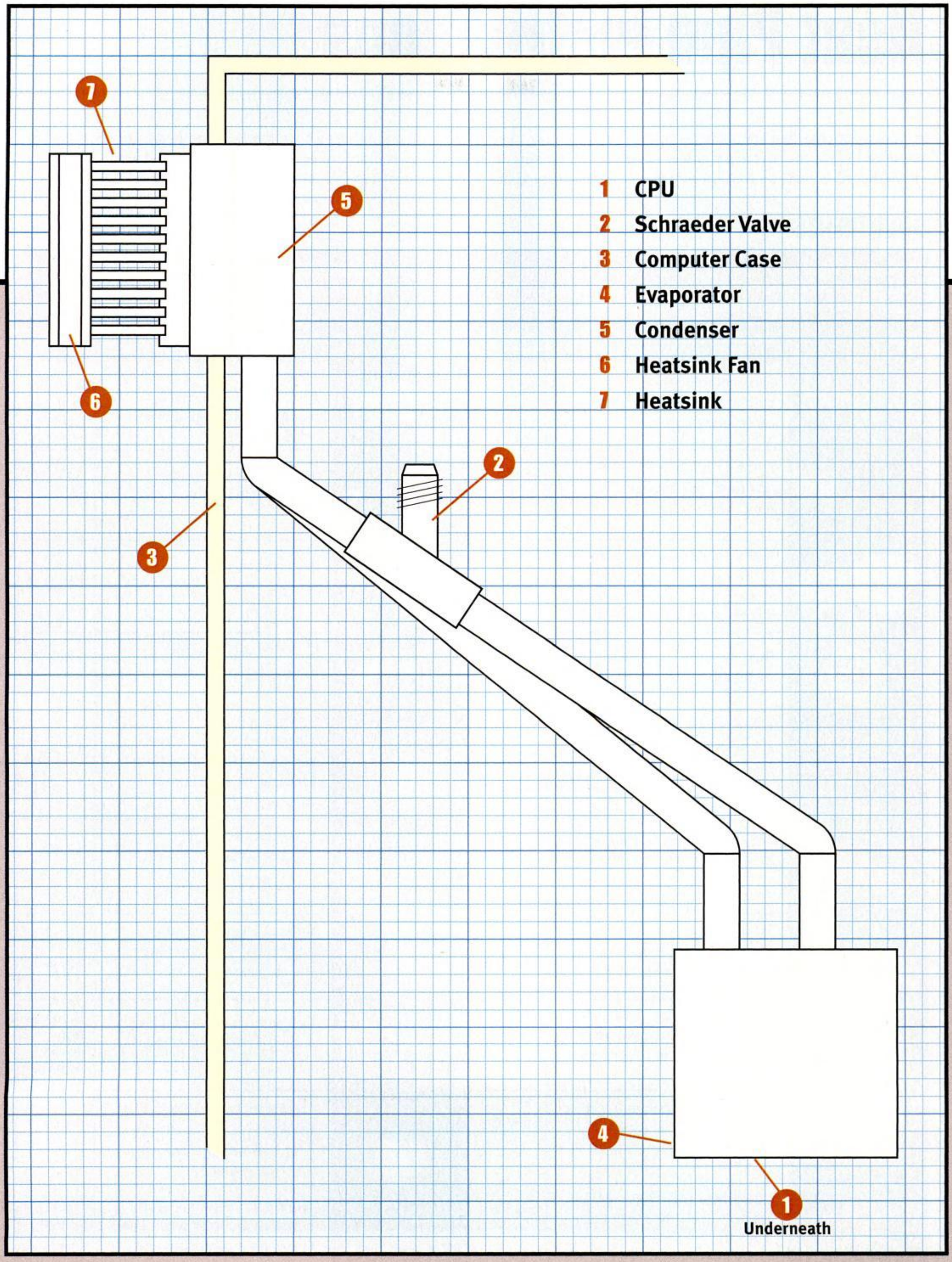

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Heat Pipe Instructions

Be sure your case has adequate room for the condenser to sit above or below your system's power supply. Also, be sure the motherboard is built so that it can accommodate the evaporator and piping. We chose the Iwill motherboard for this very reason—it didn't have any transistors that were in the way of the heat pipe's tubing.

INGREDIENTS

Most of what you need for this project can be purchased at your local hardware or plumbing store. A few components were specially ordered from Melcor (www.melcor.com), a company that specializes in thermoelectric components.

Item	Description	Price
	Dremel tool with a cutting blade—for cutting holes in the case.	$34.95
	Bernz-O-Matic torch—or any torch hot enough to melt silver solder.	$8.00
	Water-soluble flux and solder—the flux is for cleaning the tubing so the solder will stick to it when it cools down.	$7.00
	Tape measure (ours was 12 feet long).	$12.95
	4 feet of 1/4-inch copper tubing.	$4.65
	1/4-inch copper T-fitting—for installing schraeder valve.	$0.45
	Swagging tool—a tapered, conical piece of metal that "flares" out copper tubing.	$7.95
	1/4-inch schraeder valve—the copper version of a tire-valve, with a valve stem that keeps the water inside.	$1.95
	Liquid-heat exchanger (Melcor #LI-401-CL)—the condenser that cools down the water.	$54.95
	Liquid-heat exchanger (Melcor #LI-102-CL)—the evaporator that's the heat-bearing receptacle for the entire project.	$52.35

Item	Description	Price
	2.5-gram packet of thermal epoxy (Melcor #TCE-001)—will permanently bond the Alpha heatsink to the condenser.	$17.10
	Alpha heatsink and fan (Melcor #PAL6035).	$31.10
	Marking pen.	Approx. $1.00
	Drill and drill bit—for drilling holes in the case.	$200.00
	Uncontaminated syringe—for injecting the water into the heat pipe. Be sure it has measurements on it.	$2.00
	Cutter—for cutting copper tubing.	$7.00
	Brass bracket (plus nuts and bolts)—for mounting the condenser.	Approx. $5.00
	Heatsink attachment—for socket-based motherboards.	Ganked from an old heatsink
	Optional: Thermal grease (Melcor #TG-003)—transfers heat between the processor and evaporator.	$4.65
	Optional: Paper clip—for removing bubbles when injecting water into the heat pipe.	Found on the desk

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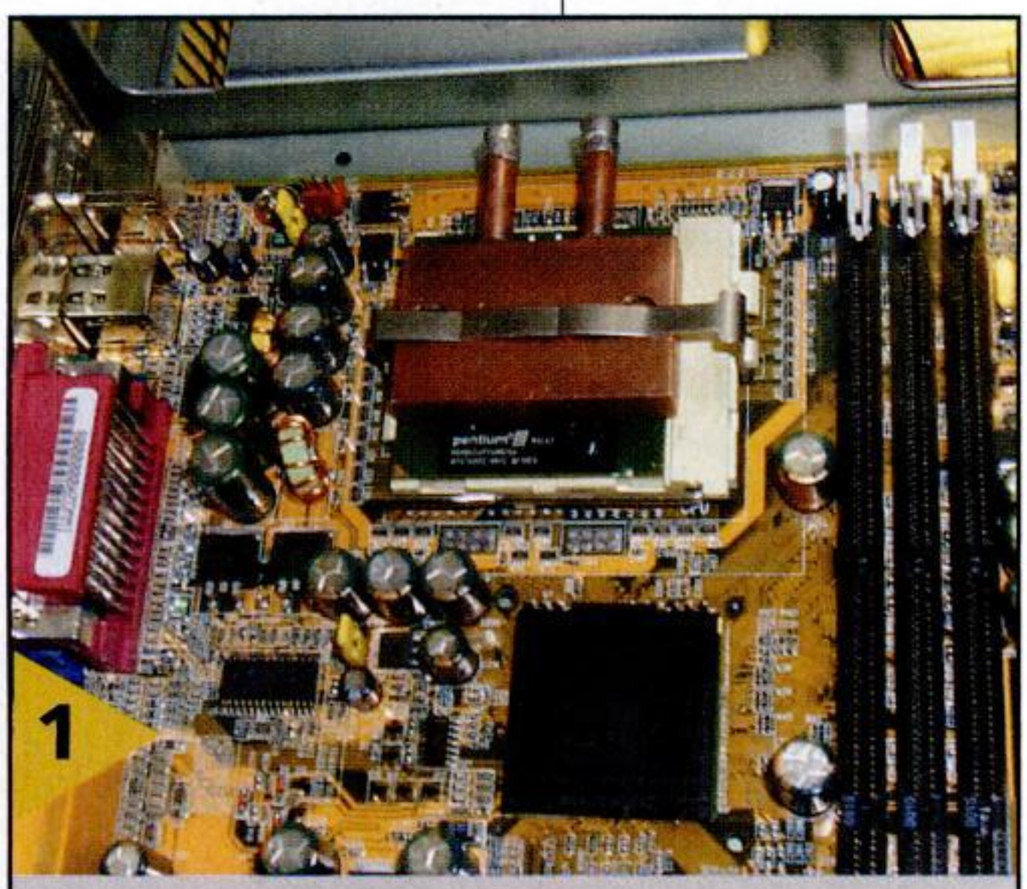
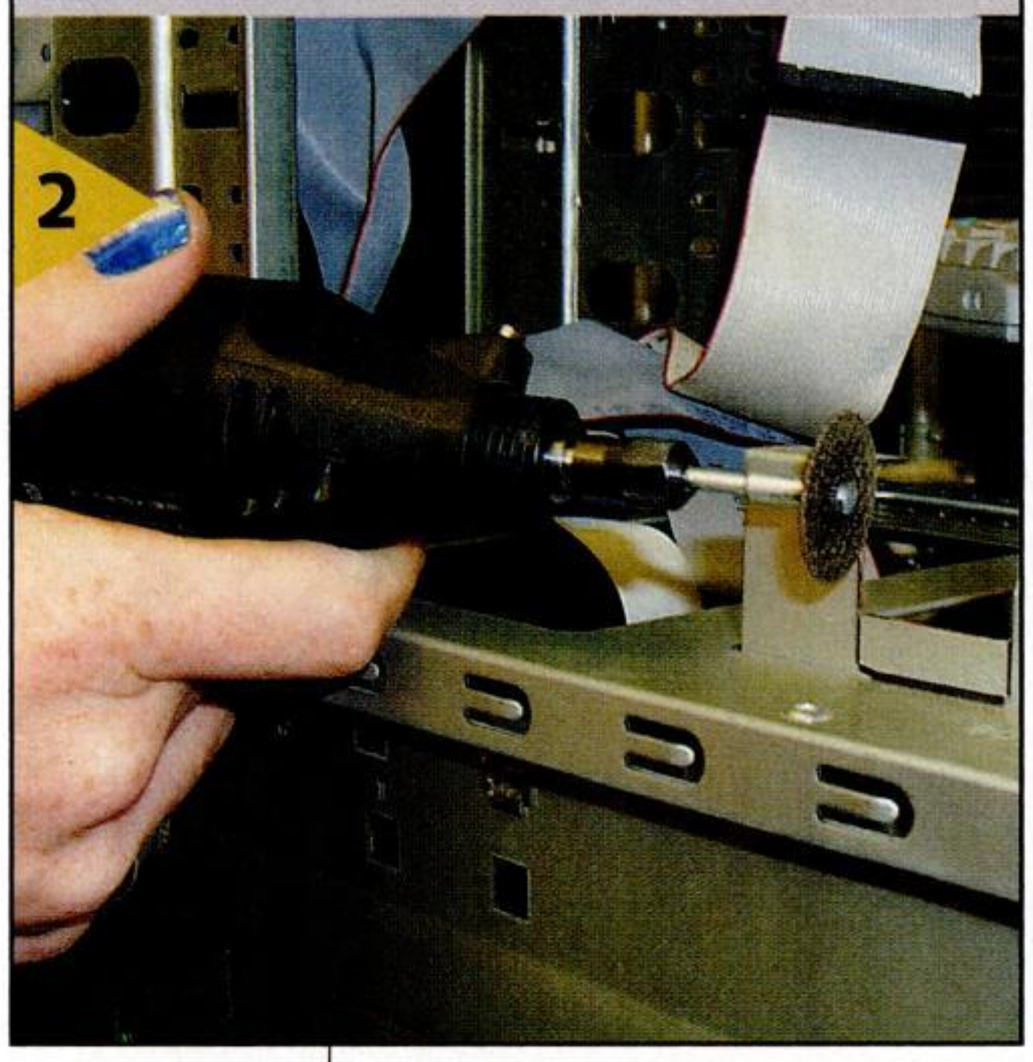
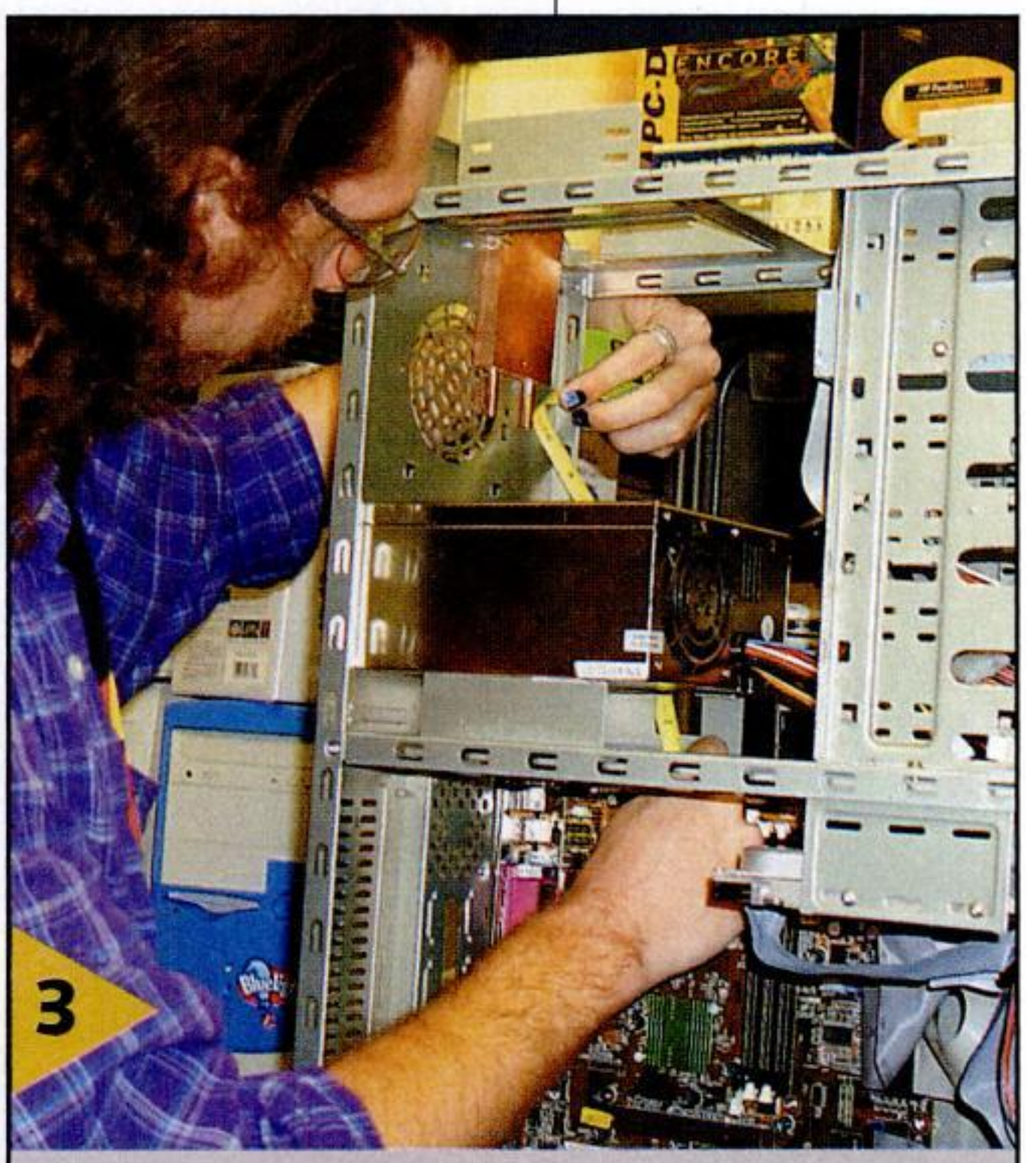


Put the evaporator on the processor and the condenser in the case. We secured our evaporator with a heatsink attachment we stole from an old heatsink. Consider the best way to route the heat pipe's tubing through the case, keeping in mind that two lengths of pipe need to run between the condenser and the evaporator (see the diagram on page 65), and that both need to clear all the other components inside your case. The condenser is going to sit flush with the case itself—the heatsink attached to the condenser is going to jut out of the case.

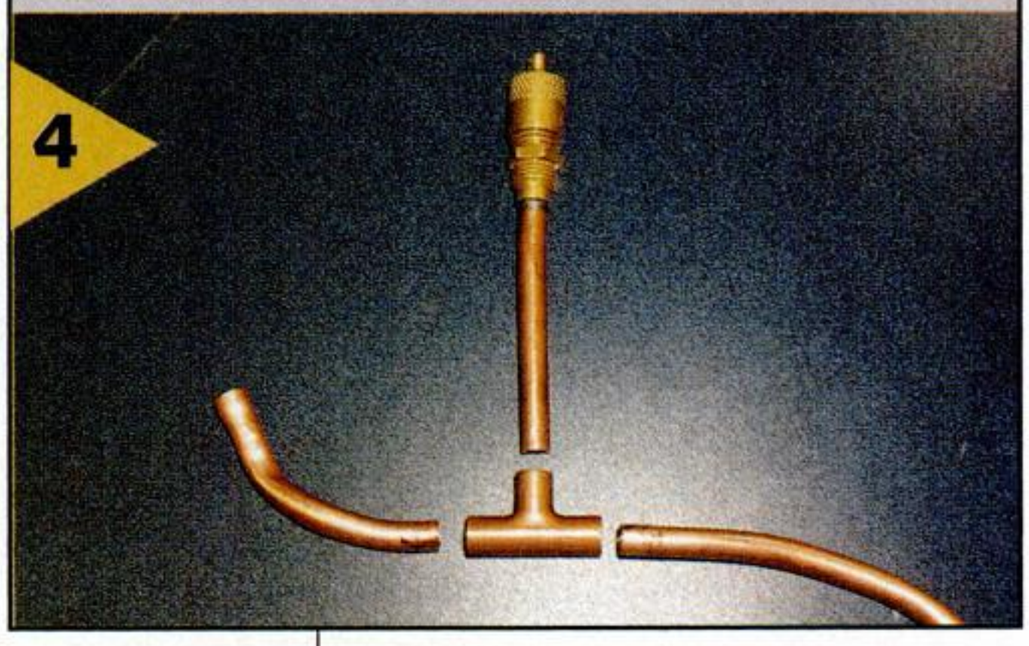
Mark the places where you need to cut holes for the tubing and the condenser to stick out, and for the mounting bolts. Remove the power supply and motherboard so metal case filings won't sully them when you start cutting. Cut the holes for the condenser and tubing as marked using the Dremel tool. Drill the holes for the condenser's mounting brackets. Mount the condenser onto the case using the brackets, nuts, and bolts.





Install the motherboard, with the evaporator attached to the proc. Measure the distance between the evaporator and the condenser—that's how long the copper tubes between them need to be.

The heat pipe involves two lengths of tubing. One is a single, unbroken tube that runs straight from the condenser to the evaporator. The other is made up of two pieces of tubing connected in the middle by the 1/4-inch T-fitting and the schraeder valve. When you cut the length of unbroken tube, cut it an inch longer than the measured distance, to allow for proper fit and for bends you may need to make in order to fit it through the case. When you cut the tubing for the side that will hold the valve, don't add the extra inch—the T-joint will add that length. Determine where you want the valve to be once the heat pipe is assembled (the only rule of thumb here is to be sure it's not in the way of anything else) and cut that second length of pipe in two.



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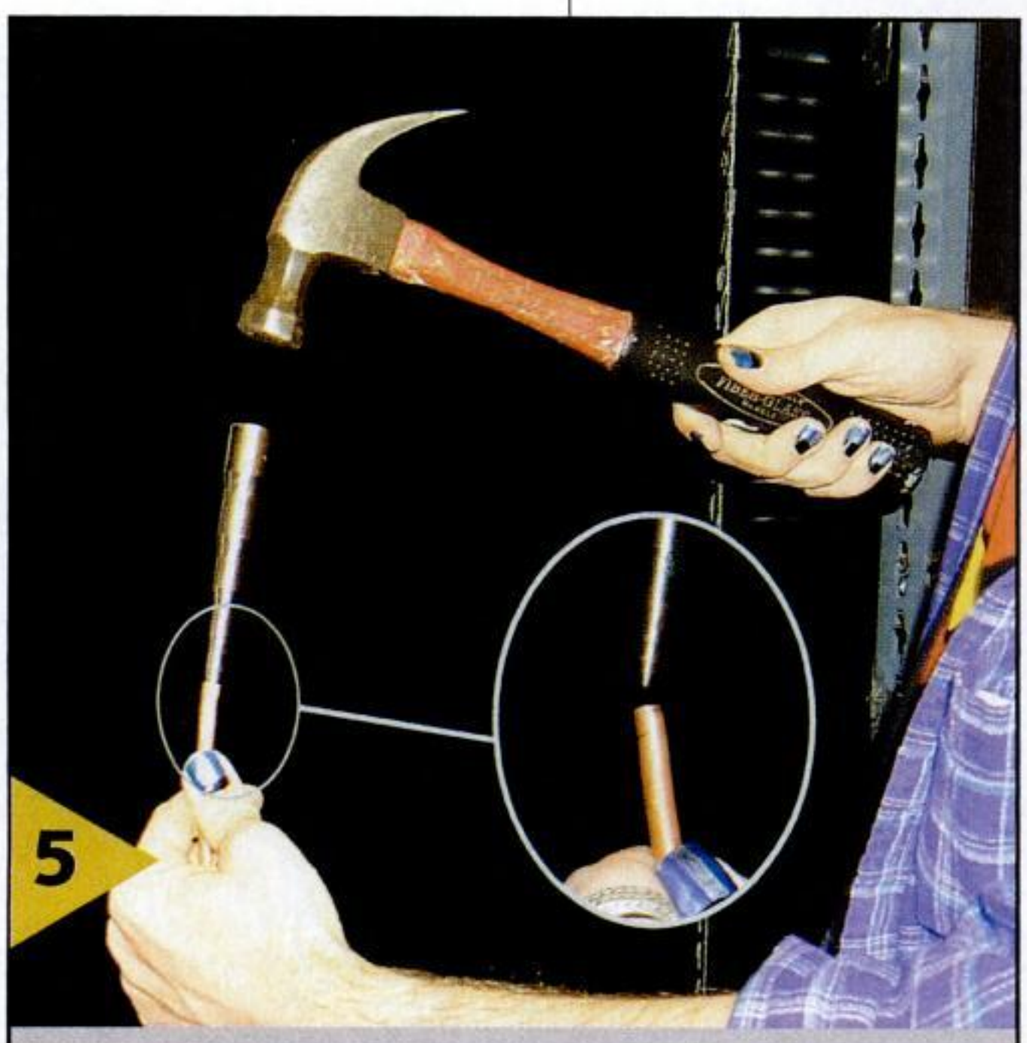
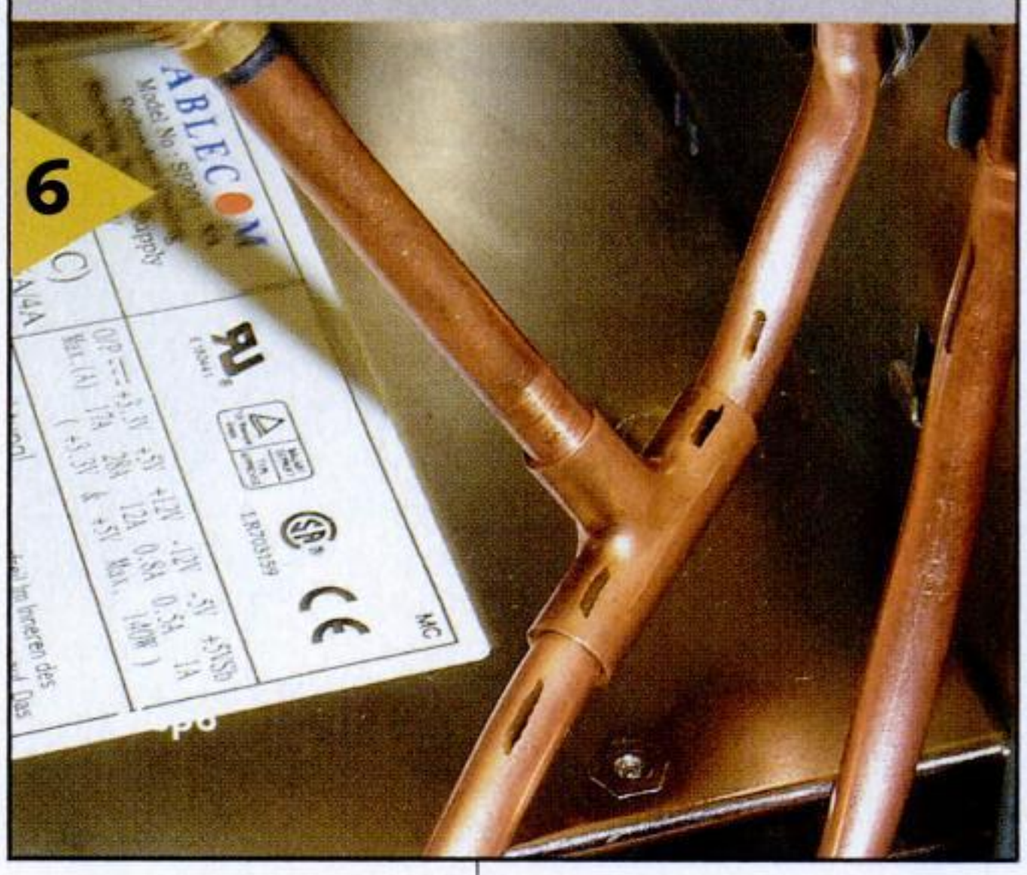
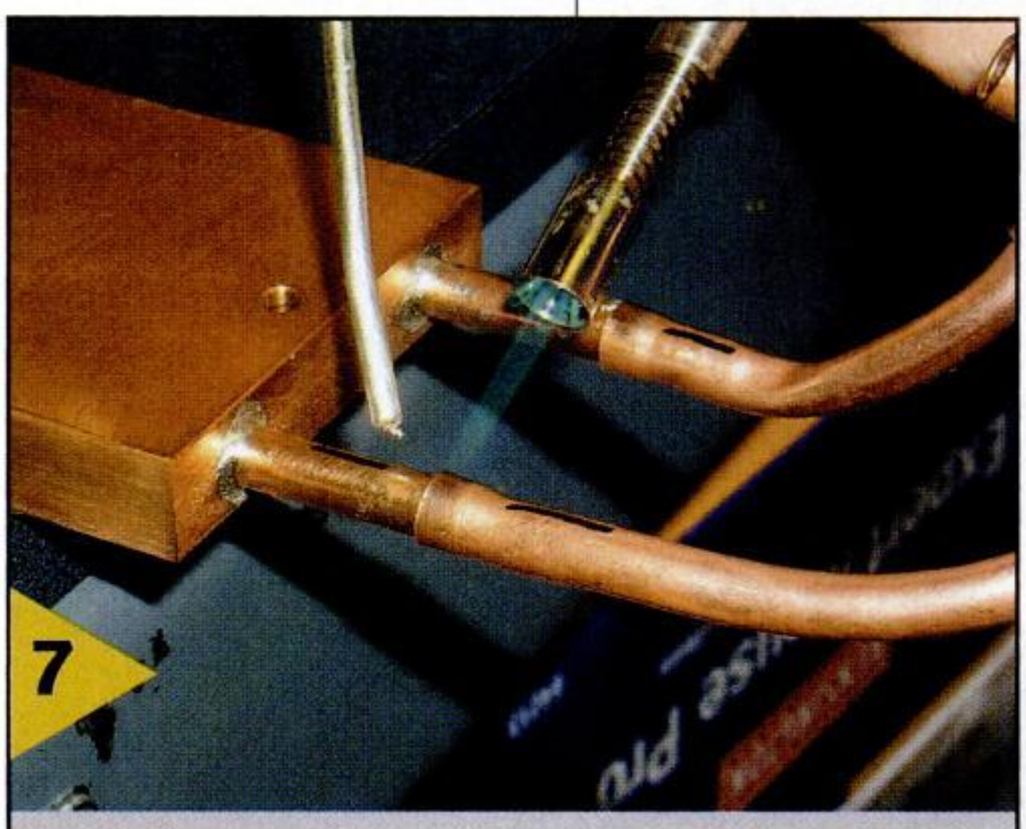


Use the swagging tool to enlarge the ends of the long tube so they'll fit securely onto the evaporator and the condenser. You want to make the ends fit together as tightly as possible. Do the same to the ends of the two shorter pieces of tubing that will fit into the condenser and evaporator, but not to the ends that will fit into the T-joint.

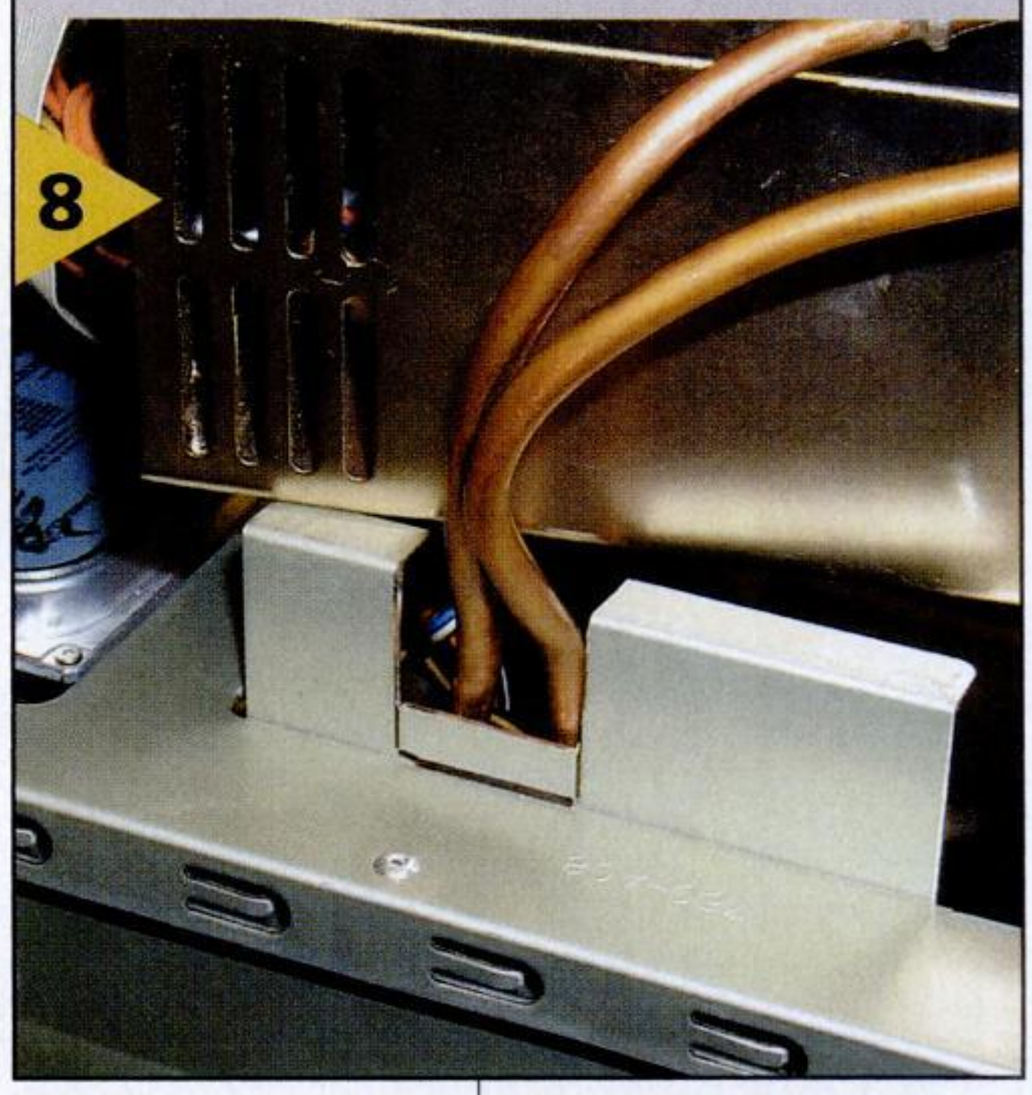
With the evaporator installed on the motherboard and the condenser installed in the case, insert both sections of tubing between the two heat exchangers to complete the mock-up. Draw a line on the copper tubing across any place where two pipes, or a pipe and a joint, meet. This will ensure that you braze (solder) the apparatus properly after you've taken it out of the case. Before brazing, mix up the silver epoxy and use it to affix the heatsink to the evaporator. Let it set for 24 hours. Be careful not to spill any epoxy—the stuff forms a permanent bond.





Take the mocked-up heat pipe out of the case. Before brazing, make sure the marks you made are lined up. Fire up the Bernz-O-Matic. Apply flux to a joint before you begin brazing it. Then use your torch to heat the joint until it's hot enough to melt the solder—you'll know it's hot enough when you press the solder against it and the solder starts to flow. When that happens, rotate the molten solder around the joint. Repeat this process for each joint on the heat pipe. Before you braze the schraeder valve, be sure the valve stem—it's inside the schraeder valve—is removed.

Depending on your case, you may need to remove the power supply before installing the heat pipe. Our SuperMicro case required that our pipe take a detour under the power supply, so we had to remove the power supply, install the heat pipe, then reinstall the power supply to get everything to fit properly.



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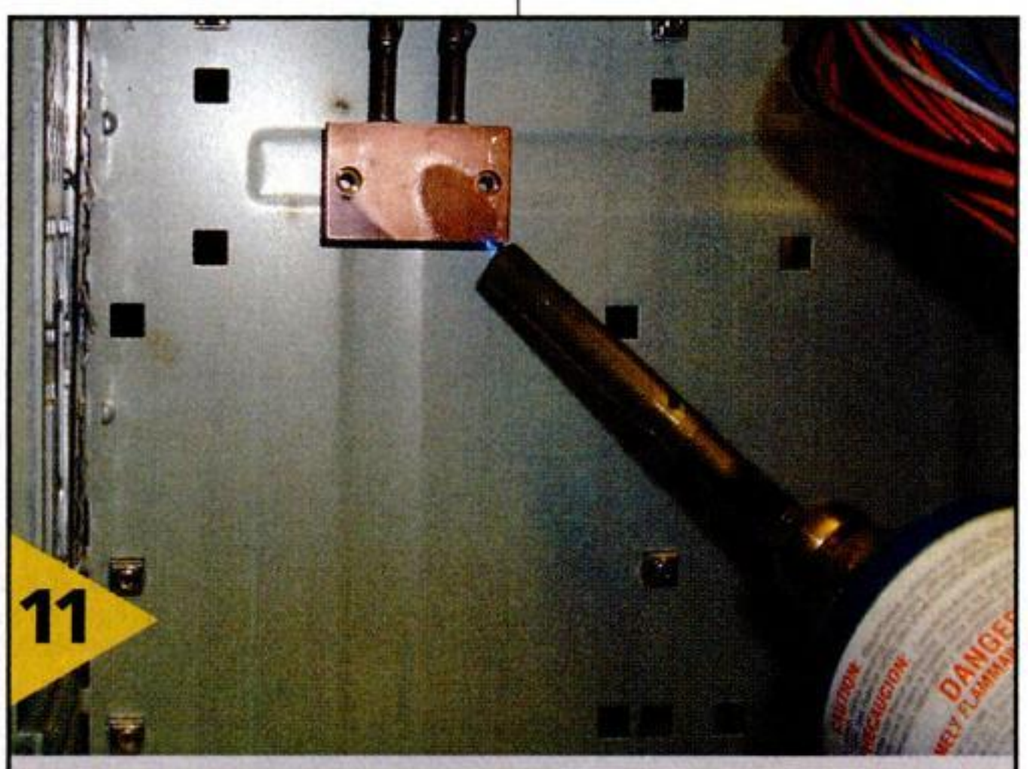
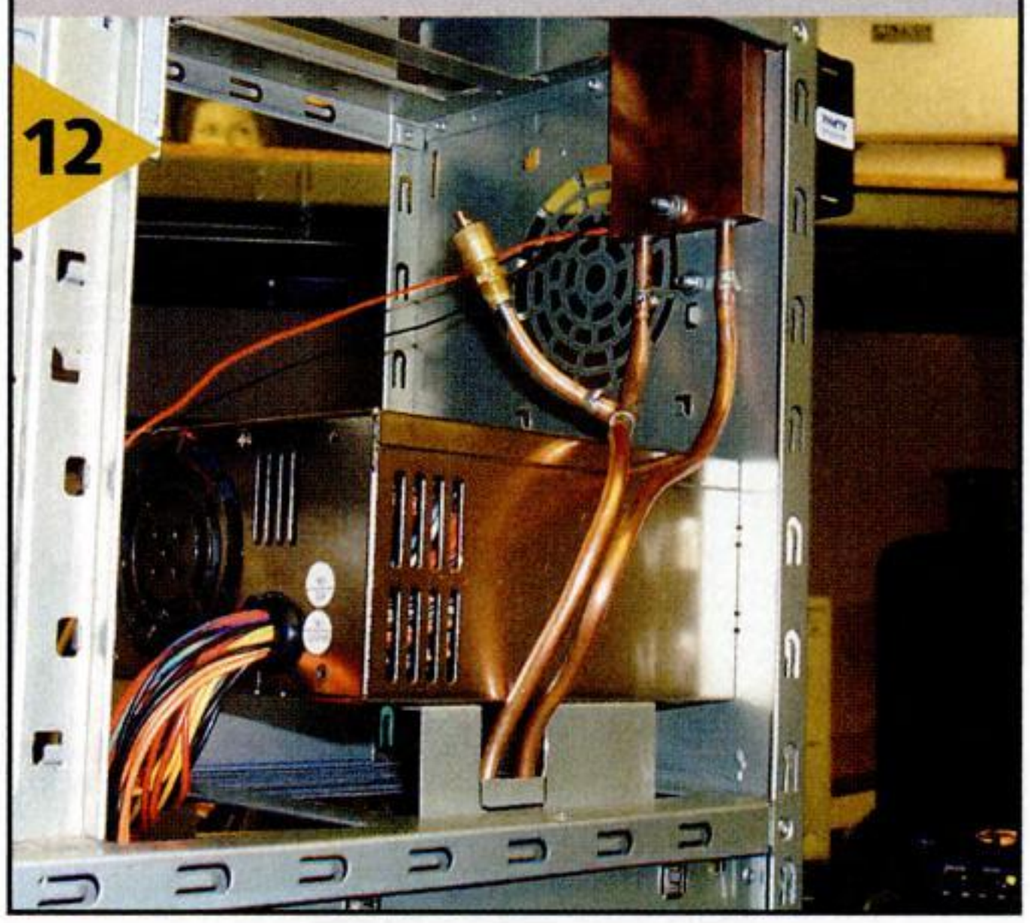
Install the fan on the evaporator's heatsink. Run the fan's wires back into the case so you can connect them to the power supply. You may need to use the Dremel to make a small hole in the case through which you can run the wire.



With the motherboard removed, use your torch to apply heat to the evaporator. Don't overheat it, but apply enough heat so the water temperature inside the heat pipe will rise, which will increase the pressure. The goal is to raise the water pressure to see if leaks appear at the joints. We left the torch on for about five minutes.

Use the syringe to inject distilled water into the heat pipe through the open schraeder valve. Fill it to the top—our heat pipe took 16.5 cc of water. Have a stretched-out paper clip handy to pop bubbles that form while you're injecting the water. After filling the heat pipe, re-insert the valve stem into the schraeder valve.

Secure the heat pipe to the motherboard—we used that attachment we stole from an old heatsink. Bolt the heat pipe to the case with the bracket. Power on and get ready for overclocking goodness.



DID IT WORK?

After installing the heat pipe, we fired up our machine and went to town. We ran a series of tests to find out how well the heat pipe could cool an unlocked, overclocked Pentium III 600EB processor, compared with the cooling capabilities of an Intel-supplied stock heatsink.

Our testing showed that the unlocked proc was far more overclockable with the heat pipe installed. In fact, our heat pipe ran roughshod over the standard Intel heatsink, allowing the Pentium III 600EB proc to boot at 733MHz—the heatsink-equipped proc got to 653MHz and no further.

WARNING:
Be aware that this project involves risk to your entire PC. If you don't have the skills to create the heat pipe or know a friend who can do it, don't send us hate mail when your poorly brazed joints leak pressurized water all over your shiny new components.

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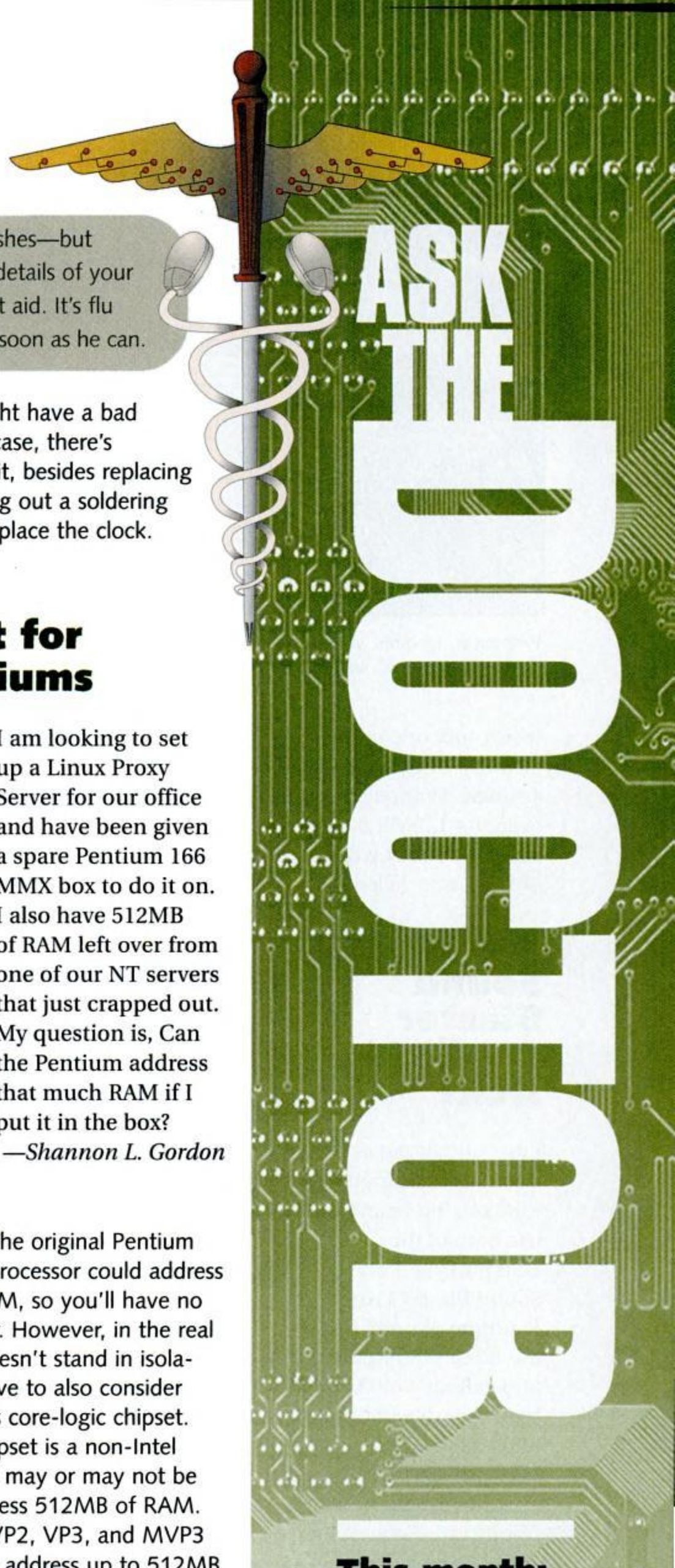
We've all made New Year's resolutions to make our PCs run faster with fewer crashes—but who actually keeps their resolutions? Relax, The Doctor is here to help. Send the details of your dilemma to **Doctor@maximumpc.com**, and we'll do our best to administer first aid. It's flu season, so the waiting room is full right now—The Doc will get to your question as soon as he can.

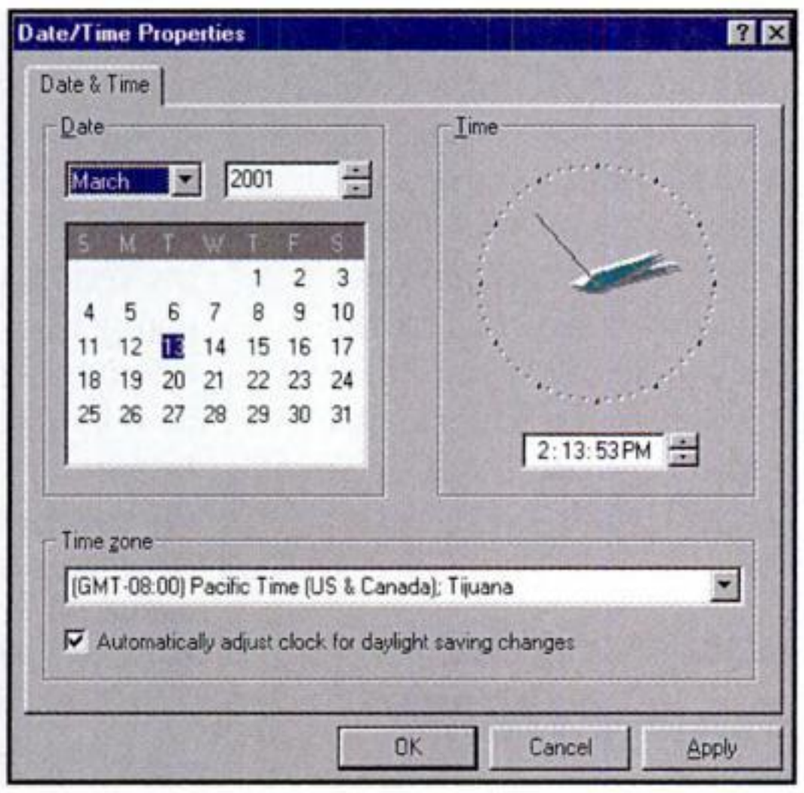


Time Keeps On Ticking

I have a serious problem with numerous computers at work: The clocks on the taskbars jump and lose time. Is there any known way to resolve this problem? I have gone to tons of newsgroups and have even read an article about Windows that discusses this issue, but have never seen a fix to resolve the problem.

—Adam M.

The Doctor has a machine with this exact problem, which is a known issue that crops up in Win95, 98, 98SE, and ME. Microsoft says a two-minute to one-hour time loss can occur every day and credits two distinct possible causes:



Certain conditions can make Windows 98's internal clock do the time warp.

▶ Advanced Power Management could be the culprit. APM settings in the BIOS could cause problems with your motherboard's internal battery and Window's ability to read the clock. If you have APM disabled in the BIOS, Windows won't be able to read the internal clock and update itself accordingly. So make sure that power management is enabled in your BIOS.

▶ Microsoft also says that third-party programs could futz with your clock settings, unbeknownst to you. Anti-virus apps, system utilities, and screen savers could potentially change your time settings. To see if this is the case, simply disable each one for a day and see if the clock starts working the way it should. Work your way through all the third-party apps you think may be causing the problem until you isolate the offending software.

> **This is a known issue that crops up in Microsoft's Windows 9x products.**

The Doctor found that neither of the above causes was to blame for his own problem. I actually suffered from a thoroughly rotten system clock; APM settings were never an issue. I suggest you open a DOS prompt, type "time" and then press **Enter**. If the reported BIOS time is the same as what appears in your Windows Taskbar, your battery is fine and doesn't have a problem—instead, you might have a bad system clock. If this is the case, there's nothing you can do about it, besides replacing your motherboard or pulling out a soldering iron to remove and then replace the clock.

RAM Support for Humble Pentiums

I am looking to set up a Linux Proxy Server for our office and have been given a spare Pentium 166 MMX box to do it on. I also have 512MB of RAM left over from one of our NT servers that just crapped out. My question is, Can the Pentium address that much RAM if I put it in the box?

—Shannon L. Gordon

The original Pentium processor could address up to 4GB of physical DRAM, so you'll have no problem with the processor. However, in the real world of PCs, your CPU doesn't stand in isolation; you have to also consider your mobo's core-logic chipset.

If the chipset is a non-Intel chipset, you may or may not be able to address 512MB of RAM. VIA's VP1, VP2, VP3, and MVP3 chipsets can address up to 512MB of physical DRAM. ALi's Aladdin IV (a.k.a. TXPro) can only address 64MB of DRAM, unless an optional tag RAM chip is installed, giving the Aladdin IV support for 512MB. In most configs, the Aladdin IV almost never has this tag RAM installed. The Aladdin V fixed the problem by supporting up to 1GB of DRAM out of the box.

As for Intel chipsets, the 430FX and 430VX only support 128MB of RAM and take a caching penalty when using RAM amounts above 64MB. The 430TX can address up to 256MB but also suffers a caching penalty when using more than 64MB. The best Pentium chipset is the 430HX,

This month:

- Time Keeps on Ticking
- RAM Support for Humble Pentiums
- Sound Blaster Conflicts
- RIMM Woes

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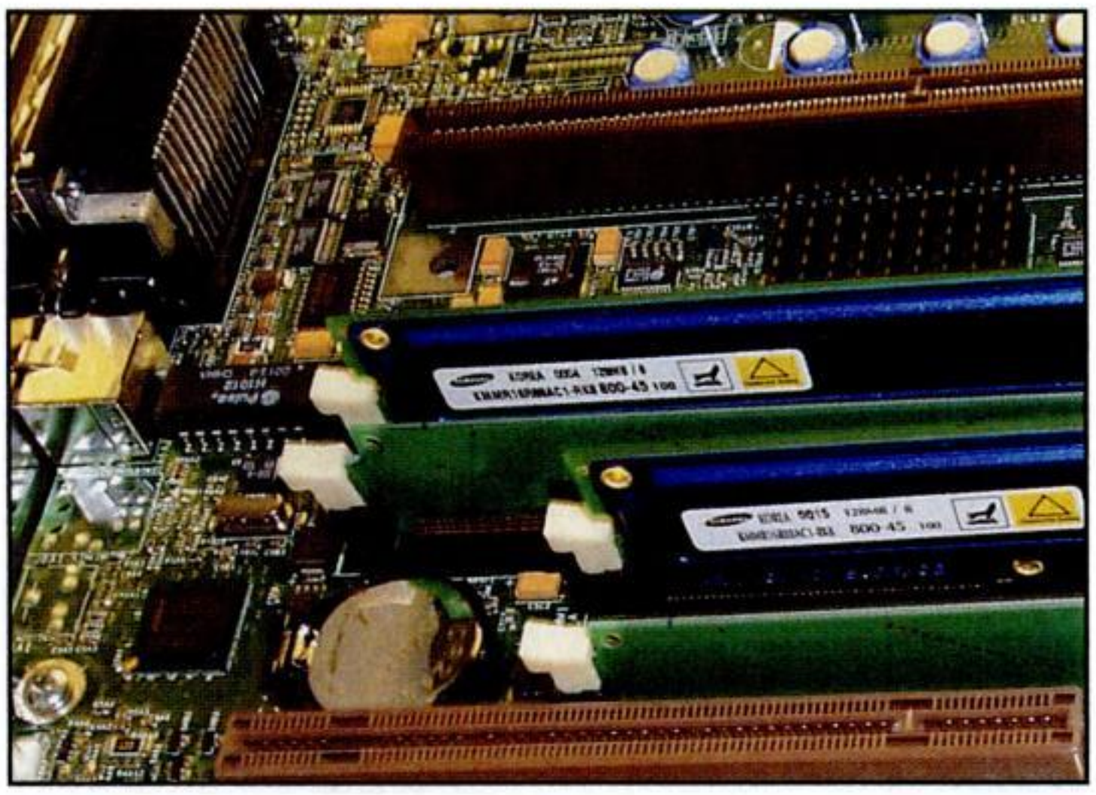


Without terminators, your dual-channel RDRAM rig won't even boot, let alone thump a T-bird.

which supports up to 512MB of physical memory when an optional tag RAM is installed. Without the tag RAM, the 430HX supports 128MB of RAM but suffers a caching penalty when more than 64MB of RAM is installed.

Sound Blaster Conflicts—ACK!

> **You must have terminators installed with each RIMM so the circuit is completed.**

I just purchased a new Asus A7V motherboard, but I can't use both of the USB ports and my Sound Blaster Live! Platinum. When I installed the soundcard, the dual USBs wouldn't come up. I tried reinstalling Win98, and it froze during hardware detection. After completing the reinstall, the USBs showed up in System Manager, but they were afflicted with the exclamation point (which I like to call the "footprint of nonexistence").

If I remove the devices and restart, Windows' new hardware manager attempts to reload the drivers but freezes up when the software loads. I tried the latest USB drivers from VIA with no luck, so I gave up and started to install the rest of my hardware. As soon as I installed my soundcard, the USBs started reloading, the software finished loading, and the computer restarted. However, Windows would not finish booting except in Safe Mode or if I disabled the USBs in System Manager.

After some more fumbling, I tried removing my soundcard, and the USBs worked fine. I tried updating all the VIA drivers, the BIOS, and the Sound Blaster drivers. The system works fine with an older sound-card based on an ESS Maestro chip, but I don't want to give up my Live! card. What can I do?

—Jonathan H.

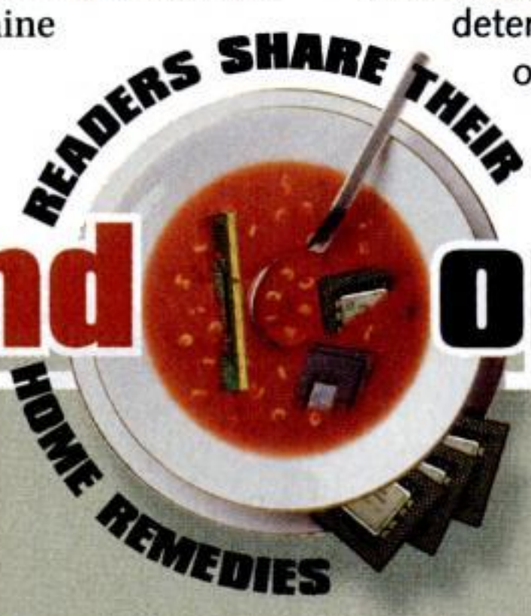
It looks like you've encountered the horrible IRQ switcheroo problem. The easiest way to fix this issue is to move your Sound Blaster Live! to different PCI slots until it works correctly. After consulting our little black book of dark PC secrets (and contacting Asus) we found out that the A7V shares IRQs among PCI slots 4 and 5 and the onboard USB controller. So, with this in mind, you'll want to move your soundcard to PCI slot 1, 2, or 3 to alleviate the problem. Asus also tells us that slots 1 and 2 share IRQs with the AGP Pro slot, so the best possible spot for the IRQ-hogging Sound Blaster Live! is in PCI slot 3.

Didja Split Your RIMM?

I've attempted to recreate your Dream Machine from the September issue, but I've run into a problem. My problem is that I can't get the motherboard to boot. All I get is beeps from the system. I'm using a different motherboard—the SuperMicro PIIIDR3—but it has the same Intel 840 chipset that you used. After consulting my manual, I found the beeps indicate a memory error. I've made sure my 128MB RIMMs are seated correctly. Is the memory bad, or have I done something wrong?

—Steven Sikes

Well, Steven, it sounds like you're looking in the right vicinity, but have you checked to see if your RIMMs are installed correctly? Since the 840 chipset has dual-channel RDRAM support, it requires you to have your RAM split. So if you want 256MB of total system memory, you must have two 128MB RIMMs, one on each channel. On top of that, you must have terminators (often called continuity RIMMS) installed with each RIMM, so the circuit is completed. Without this, the system won't even boot. Instead, you get beep codes telling you something is wrong. All RDRAM systems are this way. So if you have a single-channel RDRAM system (as on 820 chipset boards) you'll still need a terminator to close the circuit. However, with some Pentium 4 systems we've seen, the channels are aligned differently, in that the RIMMs sit next to each other while the terminators sit in the other banks. Just make sure you check your motherboard manual to determine the exact positioning of your terminators.



second opinions

Heatsink Fan Direction

I have been a power-supply design engineer for several years and would like to add an addendum to your recent question concerning fan direction on a CPU heatsink. I think the fan should blow down onto the CPU heatsink due to the effect of "impinging" airflow. This allows use of smaller heatsinks to get more heat out of the processor. This impinging airflow is very effective in removing heat from the "diced-up" heatsink fins. Other system fans get the heat out of the case, as the airflow article (Lab Notes, November 00) discusses. Blowing cool air down is a good idea, but the air is already somewhat heated by mixing with the internal air.

—Mark Dennis

Thanks, Mark. One other thing to consider is that most people turn the fan with the "label" facing up. This isn't always the best way to have the fan pointing. Most fans have indicators on them to show which way the fan blows.

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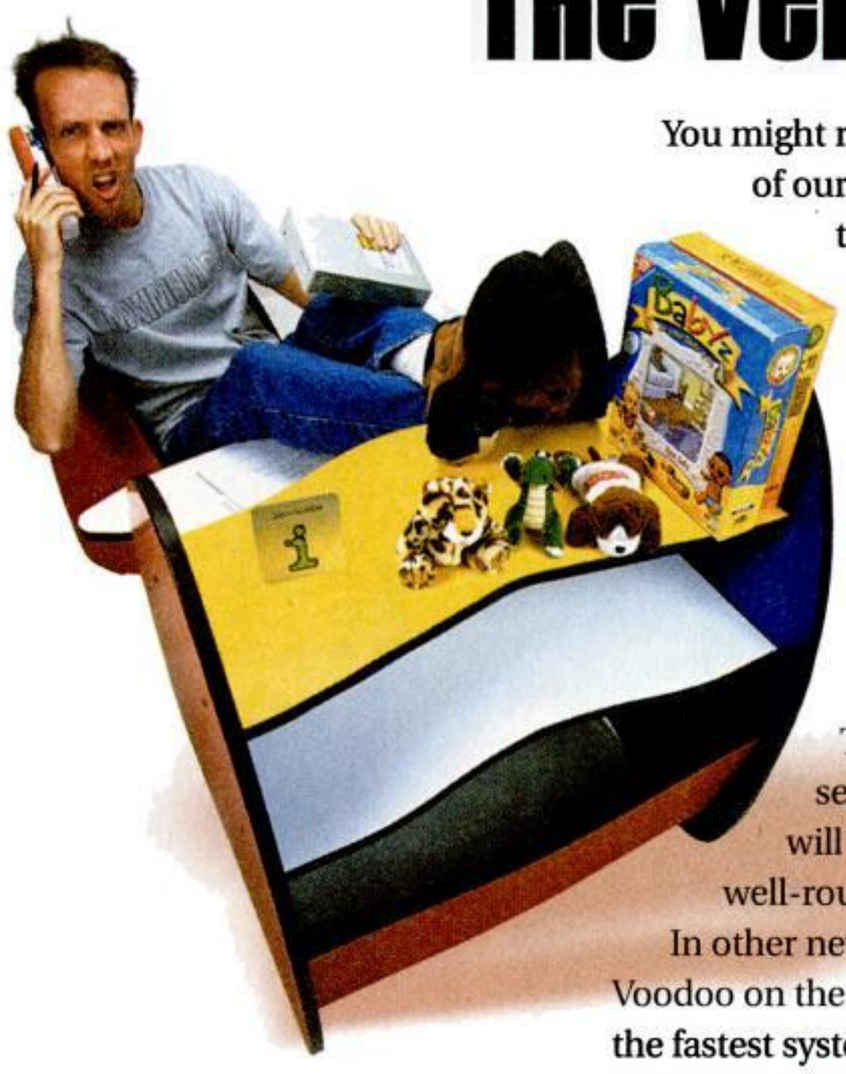
The Verdict on Game Verdicts



You might recall that we recently shifted the focus of our game reviews. We're now spending more time critiquing underlying technology (that is, the code that challenges the hardware) and less time on plot lines and a game's general "fun factor." Of course, the new focus affects game review verdicts. For instance, how do we rate a game such as *Diablo II* that isn't technically innovative, but is nonetheless a blast to play? The solution is to implement a dual-verdict system for game reviews. Technology and gameplay will now receive separate verdicts, and the Kick Ass Award will be reserved for games that provide a well-rounded, top-notch experience.

In other news, check out the awesome system from Voodoo on the next page. It's a Perfect 10, folks. It's one of the fastest systems we've seen this year, and its menu of features is superlative. Sure, the year is only one month old, but, damn, this box rocks (and it's got the cleanest wiring we've ever seen).

—JOSH NOREM, REVIEWS EDITOR

HOW WE CAN DO BETTER

In November, we asked readers to send us e-mail telling us how we can learn from, and do better than, competing magazines. Many of your responses were inspiring, but the most impressive ideas came from Joe Dolan, who offered the following story concepts:

- 25 Secret Computer Tweaks that Attract Babes!
- 220 Volts and Dry Ice: Is It for You?
- In This Issue: L33t haXor Dictionary
- 50 Web Stalking Secrets: She'll Find Out It's You When YOU Say So
- Olde English 800: Makes Your Old Games Seem New!
- How to Royally Screw Things Up with Simple Registry Edits
- Move Around Keyboard Keys for the Hell of It: We Show You How!

The Dream Machine Life Cycle

Often feared but always coveted, the annual Dream Machine is a celebration of excessive computing power. However, like any professional performer, the Dream Machine is inevitably outpaced by new additions to its field and is retired. Slowly, it's transformed into a much different—much humbled—machine.

September 2000: The Dream Machine is born. With dual 1GHz processors, 512MB of RDRAM and SCSI everything, it pounded all other systems into submission.

One month later: The Dream Machine retires to its natural habitat—the Lab. Editors immediately began "borrowing" parts from it.

Two months later: The Dream Machine is seen in the vicinity of Skid Row. Editors will neither confirm nor deny knowledge of the whereabouts of its components.

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A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

Lab Tested: Kmart Blue Light PC

Seems like every PC vendor and his mama want to send us a system to review. We'd love to benchmark all of them, but since we have such a limited amount of space in the magazine, we have to be choosy. For instance, this month there wasn't any room for Kmart's Blue Light PC. But because we found the PC so, uh… interesting, we made space for it below.

Dig the benchmarks! They're staggering, to say the least. The Blue Light set a Lab record—in most "would not run" scores. Its all-blue mouse is awesome for games—games that suck, that is (such as *Myst*). All in all, this is a must-have PC—if you must have crap.

They're not Klipsch ProMedias, but the Blue Light's speakers' output was surprising—surprisingly bad.

Like PCs from Alienware and Falcon Northwest, the Blue Light comes with desktop wallpaper with the company's logo. Indeed, the Blue Light is quite similar to these high-end gaming PCs—except that it's not fast or reliable. At all.

A big, blue button is the secret to this machine's ease of use. Press it to turn the PC on, and hold it down to reboot when the PC crashes. The snazzy blue paint-job will impress your friends—if your friends have no taste.

TEST	ZERO	SYSTEM	RESULTS (%)	RANK
SYSmark	300	Won't run	N/A	Unseeded
Hard Drive	25MB/sec	1021	-500.0	Unseeded
CD-ROM	40x	Won't run	N/A	Unseeded
Photoshop	250sec	Won't run	N/A	Unseeded
Direct3D	40fps	24.2fps	-7.0	Unseeded
OpenGL	40fps	18.24fps	-9.4	Unseeded

The Blue Light PC costs $650 (with a 15-inch monitor). It includes a 633MHz Celeron, a 66MHz system bus, 32MB of PC100 SDRAM, a printer, and onboard video, care of the 810 chipset. A sticker warns you that opening the case will void the warranty, but the system comes with a mini-vacuum. For what purpose? To vacuum up keyboard grit?

Lemon of the Month

BENWIN GX-6 SPEAKERS

These speakers produce nothing but distortion at anything higher than mid-volume. Had they been officially reviewed, they could have been the first recipients of a negative verdict.

22 PRODUCTS REVIEWED!

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Voodoo Monsoon-XS Egad

THE DEFINITION OF KICK ASS

This PC will put you under its spell.

The Voodoo Monsoon-XS Egad (no relation to 3Dfx) is easily the most impressively configured (and oddly named) machine we've seen in the past year—and that's saying a lot, considering the plethora of powerful systems we've had the pleasure of benchmarking lately.

We won't bore you with all the specs, simply because there are too many incredible parts to list. But chew on these for starters: It's got an ATA/100 RAID array with two 75GB IBM 75GXP hard drives (for math dummies, that's 150GB of storage), an AMD Athlon Thunderbird running at 1.1GHz, a Plextor 12/10/32A CD-RW drive with Burn Proof technology, Klipsch ProMedia speakers, and pretty much every other mouth-watering component you can imagine.

This system also gives new meaning to the phrase "attention to detail." All internal ATA cables are routed along the edges of the motherboard for maximum clearance, making this PC the most meticulously built system we've seen, ever. The cabling job really has to be seen in person to be believed. And there's even a plastic rack behind the PCI slots that hold the cables nice and neat. Not only that, but Voodoo also includes an informative guide to every internal component, along with a description of each part's features and benefits, and an awesome soft binder with all drivers, manuals, and software bundles that come with the PC. Color us smitten.

Given this PC's impressive components and exquisite construction, we expected it to be a record breaker, and we weren't disappointed. Compared to other Thunderbird systems we've reviewed, the Monsoon takes first place in five out of six benchmark categories. However, since we're now comparing system benchmark scores with those of stand-alone components, (and Pentium 4 systems) the Monsoon doesn't fare quite as well in the new ranking board. For instance, the 40x DVD 105S drive lost in *CDTach* to Kenwood's 72x CD-ROM drive (no DVD drive will ever beat Kenwood's 61x *CDTach* drive rating), and the system's GeForce2 lost in gaming benchmarks to GeForce2 Ultra scores. In almost every benchmark category, this system was top dog, until the GeForce2 Ultra Pentium 4 systems arrived. Regardless, the Voodoo still beat the Compaq P4 in four benchmarks and lost by a hair to the Dell P4 in *SYSmark* and *Photoshop*—not bad, considering its 400MHz handicap. Still, the Voodoo is the fastest T-bird system we've seen.

Furthermore, we believe this system could have benchmarked even better than it did if it hadn't shipped with Windows Millennium as its operating system. This theory hasn't been confirmed with empirical data, but word on the street (and in the Lab) is that ME lowers scores in *SYSmark* by an average of 10 to 15 points.

As if this system's configuration wasn't swell enough, Voodoo officials told us they were going to ship the system with a Sony GDM-F500 monitor, but they wanted to keep the price below $7,000, so as not to scare people away from the product. Scared? Us? Give us more! For the deep-pocketed, Voodoo offers almost the entire line of Sony monitors, in case the beautiful Samsung SyncMaster that shipped with this system doesn't ring your bell.

Bottom line: We're speechless. This is the first system we've ever seen from Voodoo, and it's all that and a can of Pringles. Is it absolutely perfect? Not quite—Voodoo included a return label with the system. Doh!

—Josh Norem

PLUSES
- Divine craftsmanship
- Fastest OEM Athlon System we've seen
- Every subsystem is loaded
- 150GB RAID array
- We could go on and on and on

MINUSES
- Return label included with system

UNDER THE HOOD

THE BRAINS	
CPU	1.1GHz AMD Athlon Thunderbird
L2 cache	256K full speed
RAM	256MB Crucial Technologies PC133 SDRAM
Motherboard	Asus A7V Socket A
Drive bays	Four 5.25-inch (one free), six 3.25-inch (four free)
I/O ports	Midi in | Midi out | S/PDIF in | S/PDIF out Aux in | Line in | Headphones | Optical S/PDIF in/out | TV-out | VGA-out | DVI Five USB | Two serial | One parallel
DISPLAY	
Video	Hercules 3D Prophet II GeForce2 GTS 64MB DDR SDRAM
Monitor	Samsung SyncMaster 955DF 19-inch (18-inch viewable, .20-.24 variable pitch)
Refresh@ max res	60Hz@1600x1200
STORAGE	
Hard drive	150GB IBM 75GXP RAID array (two drives, RAID 0), 7200rpm, ATA/100
DVD	16X Pioneer 105S
CD-RW	Plextor 12/10/32A Plexwriter
Removable	250MB Iomega Zip
RAID	Promise FastTrak 100
NETWORKING	
NIC	D-Link 538TX 10/100 Full Duplex
SOUND	
Soundcard	Creative Labs Sound Blaster Live! Platinum with Live Drive II
Speakers	Klipsch ProMedia V.2-400 THX
THE BUNDLE	
Windows Millenium | Adaptec *Easy CD Creator 4*	

BOOT 0:52 DOWN 0:03

TEST	ZERO	SYSTEM	RESULTS (%)	RANK
SYSmark	174	205	18.0	2nd Seed
Hard drive	20.2MB/sec	37.8MB/sec	87.0	2nd Seed
CD-ROM	26x	30.2x	16.0	2nd Seed
Photoshop	170sec	110sec	35.0	2nd Seed
Direct3D	38fps	75.3fps	98.0	Unseeded
OpenGL	34.4fps	89.6fps	160.0+	Unseeded

Full benchmarking details at www.maximumpc.com/benchmarking/index.html.

MAXIMUM PC VERDICT 10

$4,550 ($4,100 w/o monitor)
Voodoo | www.voodoo.com
403-264-4530

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EXPANSION NOTES

You wanna upgrade this bad mother? Why? There's a single free PCI slot behind the 120mm fan used to cool the add-in cards, but we can't imagine what you'd put in it.

EXPANSION MAP

AGP: Videocard
PCI: Free
PCI: MPEG card
PCI: NIC
PCI: Soundcard
PCI: RAID

CASE | COOLING | POWER

CASE

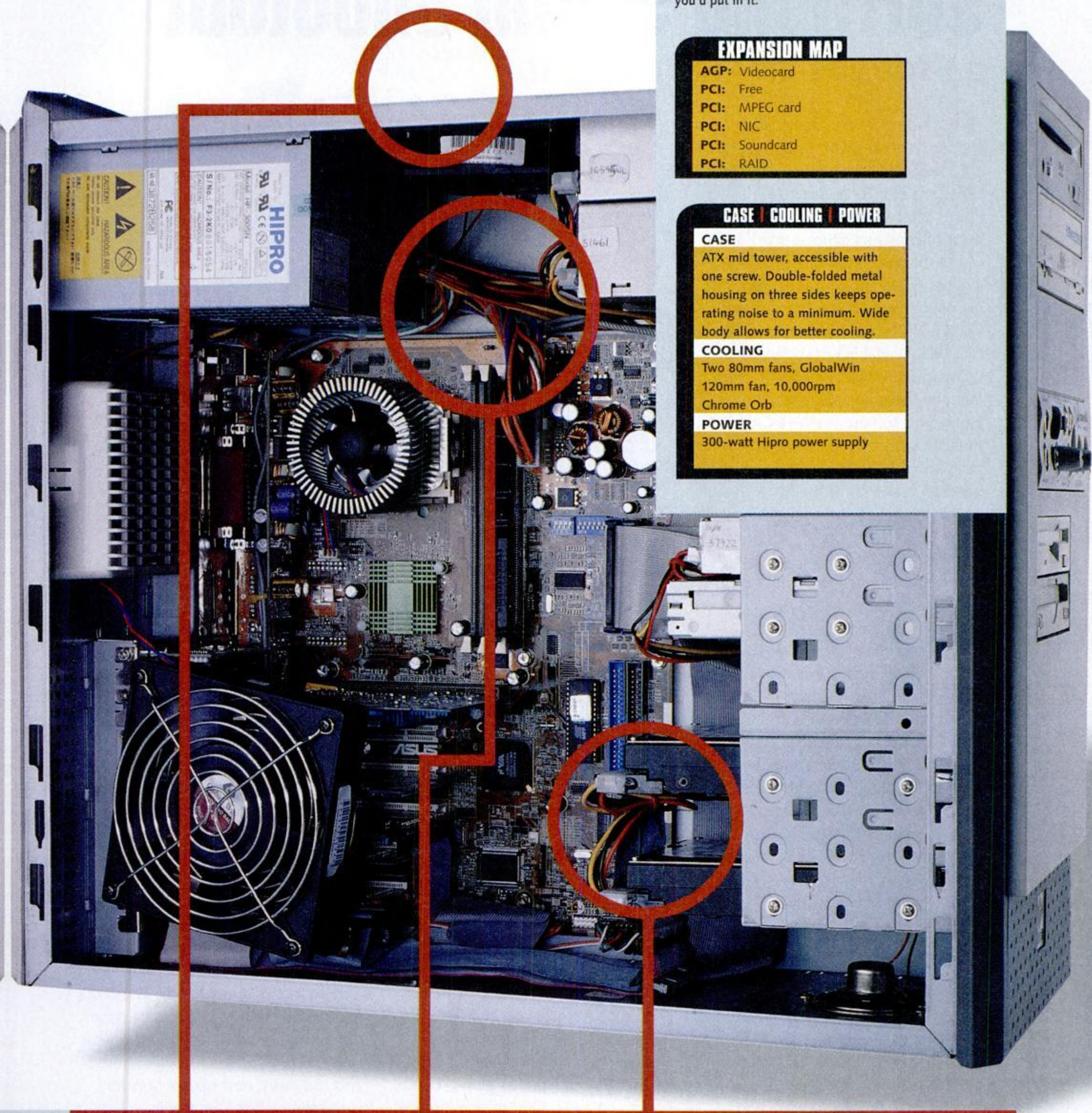
ATX mid tower, accessible with one screw. Double-folded metal housing on three sides keeps operating noise to a minimum. Wide body allows for better cooling.

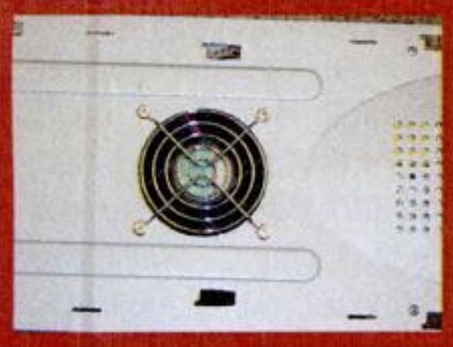
COOLING

Two 80mm fans, GlobalWin 120mm fan, 10,000rpm Chrome Orb

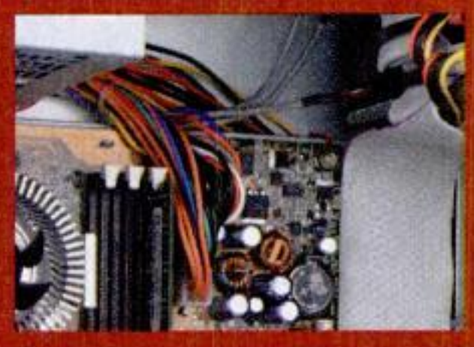
POWER

300-watt Hipro power supply





Free Willy! This blowhole—named the Voodoo Tornado—takes the hot air that rises to the top of the case and whisks it on its way.



Don't cross the streams! We've been impressed by tight wiring before, but this system sets the standard by which all others shall now be judged. We could eat our lunch inside this case.

Yep, it's a 150GB RAID array. We've seen IBM 75GXP RAID arrays in several systems, but up until now, no vendor has used the 75GB flavor. That's 150GB of storage—*Napster*, here we come!

Get your cables, sir? This clever clip keeps the rear of the PC from looking like the rat's nest of cables we're accustomed to.

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Surround Sound Shootout

5.1 SOUNDCARDS HAVE ARRIVED

The evolution of the soundcard species continues with Dolby Digital 5.1 soundcards. These new cards from Creative Labs, Turtle Beach, and Philips offer all the output jacks you need to construct either a quad surround speaker setup for gaming or a 5.1 speaker setup for DVD movies (assuming your six speakers are outfitted with the right wiring scheme). All Dolby Digital 5.1 decoding is orchestrated by the soundcard, with many of the processing chores handed off to your system's CPU—thus, there's no need for an external digital decoder box. While this sounds good on paper, consider that all but one of the 5.1 multimedia speaker sets currently available already come with an external decoder box, so buying a soundcard with native 5.1 support is somewhat redundant.

SOUND BLASTER PLUSES
- Versatile I/O options
- Integrated IR remote

MINUSES
- 3D audio algorithms need improvement
- Cluttered controls
- Upmixing into 5.1 sounds yucky

THE SPECS
SOUND BLASTER LIVE! CARD
TAD I CD in I Aux in I CD S/PDIF

BRACKET I/O
Speaker 1 out I Speaker 2 out I Mic in I Line in I Digital out/speaker 3 out

LIVE DRIVE IR
External S/PDIF in / out I Headphone I Aux in I Line in I MIDI in / out

THE SPECS
SANTA CRUZ CARD
Aux in I CD in I TAD in I CD SPDIF in I Wave table header I Expansion port

BRACKET I/O
Speaker 1 out I Speaker 2 out I Line in I Mic in I Speaker 3 out/ digital out /stereo line in

In theory, a perfect 5.1 soundcard would allow you to enjoy quad surround gaming and Dolby Digital 5.1 DVD playback through a single set of 5.1 speakers. However, in this roundup, only the Creative Labs card offers this feature, and only does so when connected to Creative's lackluster DTT3500 speakers.

Sound Blaster Live! Platinum 5.1

Like its predecessor, the new Platinum 5.1 features dual analog-out jacks (which can be connected to an analog 4.1 speaker system), but now also features a Dolby Digital 5.1 jack, which replaces the former digital-out jack on earlier Live! cards. The new jack performs several functions: It can be an analog connector for a subwoofer/center channel (so you can add a center channel/subwoofer to a 4.1 configuration, making it 5.1); it can be a four-channel DIN connector for use with the Creative Labs FPS FPS2000 and DTT2500 (these quad surround speaker sets use a proprietary digital connector); it can be used as a six-channel DIN with the Cambridge Soundworks DTT3500 5.1 speaker set; and it can serve as a digital-out jack for use with Dolby Digital 5.1 speaker sets with a coaxial S/PDIF port, such as the MidiLand 8200 or traditional home theater speakers.

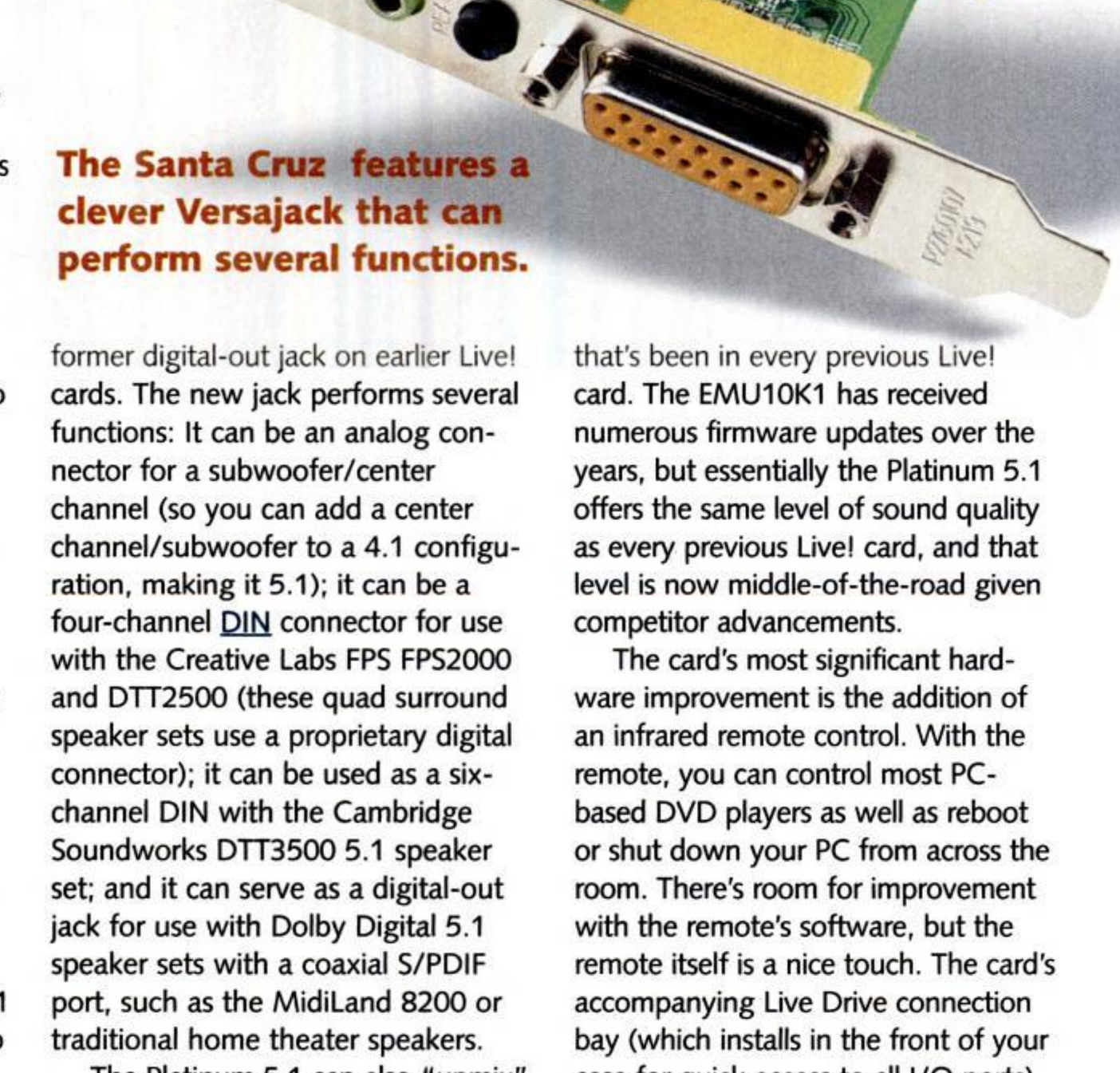
The Platinum 5.1 can also "upmix" non-5.1 sound (such as game soundtracks and audio CDs) into an approximation of six discrete channels. However, due to the card's proprietary connectors, 5.1 output for games and music is only possible when using the Creative Labs DTT3500 speakers. Owners of 4.1 speakers will have to use the card's analog outputs to get quad surround in games, and their Dolby Digital 5.1 sounds will be downmixed into four channels with a virtual center channel.

The Platinum 5.1 employs the EMU10K1, which is the same chipset that's been in every previous Live! card. The EMU10K1 has received numerous firmware updates over the years, but essentially the Platinum 5.1 offers the same level of sound quality as every previous Live! card, and that level is now middle-of-the-road given competitor advancements.

The card's most significant hardware improvement is the addition of an infrared remote control. With the remote, you can control most PC-based DVD players as well as reboot or shut down your PC from across the room. There's room for improvement with the remote's software, but the remote itself is a nice touch. The card's accompanying Live Drive connection bay (which installs in the front of your case for quick access to all I/O ports) also receives a new optical port for connecting a MiniDisc player.

On the software end, the expanded bundle consists of full versions of *Unreal Tournament*, *Deux Ex*, *MDK2*, and *Thief 2: Metal Age*, as well as a full 320Kbps MP3 encoder. On the downside, the Live! installation software places too many applications in your taskbar. They load on startup, which is annoying, to say the least.

Between the many I/O options and the remote control, the Platinum 5.1 still gets the nod for being the best all around. Unfortunately, two-speaker



The Santa Cruz features a clever Versajack that can perform several functions.

The Platinum 5.1 is worth the price for the software alone.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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3D performance (via EAX) is second best to Aureal's A3D, which offers superb 3D sound.

We love the gaming bundle and the remote, but we wish the soundcard software itself wasn't so bloated and that we didn't have to buy Cambridge Soundworks' speakers to take full advantage of the soundcard.

Turtle Beach Santa Cruz

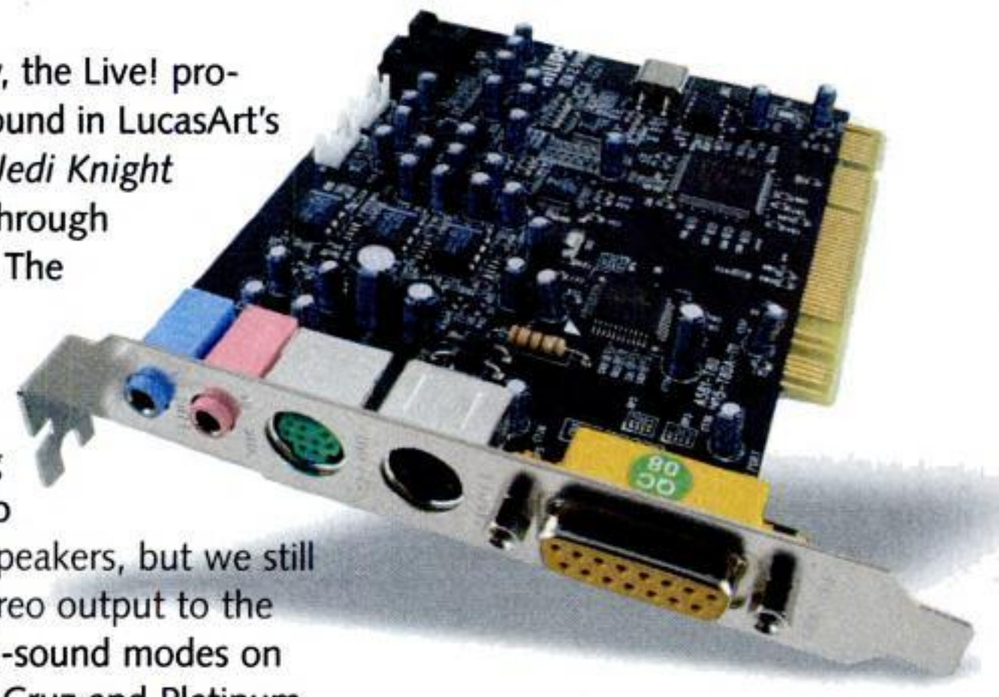
We hadn't heard from Turtle Beach since Aureal closed up shop, so we were initially excited to receive its 5.1 Santa Cruz card.

The card is similar to the Platinum 5.1 in terms of features and connectivity. In addition to its twin analog ports, the Santa Cruz sports a 1/8-inch mini jack called the "Versajack," which fulfills several roles. It can output 5.1 sound like a standard digital-out port; it can handle analog output for a center channel/subwoofer or headphones; and it can even accept a standard analog input. The best part is that the output for the Versajack is toggled in software, so you can have quad surround speakers connected to the dual analog-outs, a pair of headphones connected to the Versajack, and then switch between the two without crawling behind your PC.

Other settings are just as easy to configure, with a single control panel letting you tweak almost every feature. And unlike Creative's card, there's no need to click through endless menus and option boxes to change the settings.

The Santa Cruz uses Sensaura's MacroFX to fool you into believing you're getting 3D positional audio with just two speakers or headphones. There's also a confusing utility for fine-tuning the 3D algorithms according to your specific head shape (for times when you're using headphones). We found that the Sensaura MacroFX edged the Live! card in subjective listening tests, but oddly, the Live! produced better sound in LucasArt's A3D-only title *Jedi Knight* when playing through quad speakers. The Santa Cruz sounded slightly better when upmixing stereo signals to quad and 5.1 speakers, but we still prefer basic stereo output to the ersatz surround-sound modes on both the Santa Cruz and Platinum 5.1 cards.

If this were a stand-alone review, the Santa Cruz would rate very high. But because the other cards here offer better software bundles and hardware features, the Santa Cruz is a bronze medal winner.



A replacement for the Vortex 2? Philips Acoustic Edge delivered the best gaming audio in this roundup.

Philips Acoustic Edge

Initially, we didn't know what to expect from Philips' newest soundcard. Once we fired up a few games with the Acoustic Edge, however, we were thoroughly impressed.

Connection options on this 5.1 soundcard include a six-channel analog output (for connecting a 4.1 or 5.1 analog speaker system), as well as a coaxial S/PDIF output and input. The six-channel output consists of three mini-jack outputs that are connected to a dongle cable. This configuration allows you to connect two sets of stereo speakers, a pair of headphones, *and* something else to the S/PDIF out.

The Acoustic Edge uses QSound's 3D audio algorithms and VLSI's Thunderbird Avenger chip, which, when using quad speakers, produce superior 3D audio in gaming, as compared to the Platinum 5.1 and Santa Cruz cards. Luckily, the Acoustic Edge isn't a gamers-only card. We found that the Acoustic Edge offers the best rendering of stereo audio over quad or 5.1 speakers. Even better, the Acoustic Edge automatically expands any stereo signal into quad or 5.1 speakers.

The Acoustic Edge is the only card in this roundup to ship with DVD software, namely Cyberlink's *PowerDVD*, which has support for 5.1 output. It's a nice touch—and something both Creative and Turtle Beach should consider.

Overall, Philip's freshman soundcard is a very solid offering. Its software bundle is first rate and its audio qualities impressed us the most in this roundup.

—Gordon Mah Ung

SANTA CRUZ

PLUSES
- Versajack is neat
- Elegant interface

MINUSES
- Weakest software bundle
- Confusing sound customization menu
- Only average performance across the board

PHILIPS

PLUSES
- Best gaming audio
- Best upmixing of stereo audio
- Bundled soft DVD player

MINUSES
- Excessive CPU usage in games

THE SPECS

PHILIPS ACOUSTIC EDGE CARD

Aux in I TAD I CD in I S/PDIF in

BRACKET I/O

SPDIF in I SPDIF out I Speaker 1 out I Speaker 2 out I Speaker 3 out

SOUND BLASTER LIVE! 9

$200 I Creative Labs
www.soundblaster.com
800.998.5227

SANTA CRUZ 8

$100 I Turtle Beach
www.turtlebeach.com
800.233.9377

PHILIPS ACOUSTIC EDGE 9

$100 I Philips
www.philipsusa.com

DARE TO COMPARE

MANUFACTURER	AUDIO CHIPSET	A3D 1.0/2.0	EAX	CPU UTILIZATION WITH 24 DS/DS3D STREAMS	DIGITAL JOYSTICK*	ELITE FORCE
Live Platinum 5.1	EMU10K1	Yes/No	Yes	4%	Yes/No	73.9fps
Acoustic Edge	Thunderbird Avenger	Yes/No	Yes	6%	Yes/No	69.2fps
Santa Cruz	Cirrus Logic CS4620	Yes/No	Yes	6%	Yes/No	72.2fps

*We use the classic Thrustmaster Millennium 3D and Rage 3D for our digital joystick.

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Webcams That Do More

YOU CAN INDEED TEACH AN OLD DOG NEW TRICKS

Webcams have always been useful for video conferencing, spying on errant babysitters, and good old-fashioned voyeurism, but, until now, they've also been one-trick ponies. Small and inexpensive, webcams of old suffered the limitations of a power cord, low bandwidth, and a general lack of features found in other, more expensive, digital cameras. Webcams won't enjoy megapixel status for some time, but we're starting to see cameras with added functionality. Of the cameras reviewed here, one doubles as a scanner, and the other two detach from their power cords to become handheld digital cameras.

PHILIPS

PLUSES
- Scanning of text and 3D objects
- OCR scanning is fairly accurate
- Built-in microphone

MINUSES
- Terrible color reproduction in flesh tones
- Blues and yellows oversaturated
- Yellowish cast over everything

INTEL

PLUSES
- Portable picture taking
- Sturdy design
- LCD panel is handy

MINUSES
- No flash
- Tendency for either under- or overexposure

Philips Vesta Pro Scan PC Camera

The Philips Vesta Pro is a webcam-cum-scanner. It's shaped like an egg and looks eerily alive on its three-legged tripod, staring straight ahead with its one glaring eye. Creepy design aside, the Pro Scan offers all the traditional webcam goodies—1/4-inch CCD, 640x480 maximum video resolution, still-shot capture, and even an integrated microphone—as well as the aforementioned scanning feature that is easily one of the coolest webcam gimmicks we've seen.

After positioning the camera so it's pointing down at the scanning surface under the tripod, you can launch Xerox's *PageCam* software, adjust camera settings for optimum clarity, tighten the focus ring on the item to be scanned, and with the press of a button, capture images. Included OCR software picks out text that can be

Scanning 3D objects and pages of text are no trouble for the Philips ProScan.

easily transferred to a word processing program. Philips also includes a TWAIN driver so you can access the Pro Scan from an image editing program such as *Photoshop*, just as you'd access a flatbed scanner to bring scans directly into the program for editing.

To test the alien egg's scanning abilities, we scanned pages from Webster's dictionary, as such definitions tend to contain a variety of type treatments (e.g., italics, boldface, phonetic symbols). The results were approximately 75-percent accurate. We also scanned small, colorful toys in order to test this scanner's unique ability to capture images of 3-D objects. Our little toys were rendered flawlessly—the Pro Scan is perfect if you're looking to catalogue your collection of Star Wars action figures or vintage jewelry for online posting.

Sadly, as cool as the scanning feature is, the Pro Scan shirks performance as a traditional webcam. The integrated microphone is a nice touch, as is the tripod and the plentiful options for camera adjustments, but no matter how nice this setup is, colors were continually oversaturated—especially blues and yellows—and skin tones were exceptionally dark. The fine detail that's possible at the low frame rates used in scanning doesn't carry over well at the 30 frames per second that the webcam streams. Ultimately, we like the mini-scanner concept a lot, but as a regular webcam, its image quality doesn't compare to the other cameras in this roundup.

Intel lets loose the traditional webcam with its portable, comfortable, and easy-to-use Pocket PC Camera.

Intel Pocket PC Camera

The Intel Pocket PC Camera is a new-fangled webcam that will surely set free the traditionally constrained webcam category. Designed to look and operate like a small point-and-shoot camera, the Pocket PC Camera offers a shutter with a sound alert so

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you get audio confirmation when you snap pics; fixed focus from closeup to infinity so there's no focus ring to fiddle with; and a built-in 8MB of memory that holds roughly 128 color photos at 640x480 resolution in 24-bit color, or two minutes of video. On the go, the Pocket PC Camera operates on four AAA batteries.

A handy LCD panel tells you what shooting mode you're in, how much battery life remains, and how many pictures you have left.

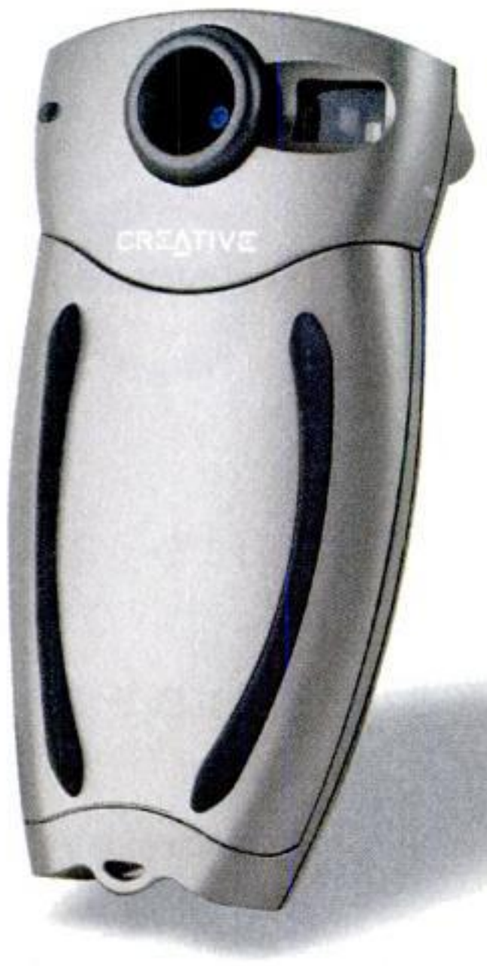
Thanks to a progressive scan CCD, pictures are fairly crisp and skin tones are accurately represented. The camera comes with a TWAIN driver so you can import photos directly into *Photoshop* after a day of shooting. The camera has a tendency to dilute colors in low light and overexpose images in areas of bright light, and, since there's no flash, lighting issues are bound to arise when using the camera on the go. We take these issues with a grain of salt, however, because this isn't a full-blown digital camera, and at this price, we know not to expect the world. For a webcam, the Intel snaps some pretty fine pictures, and image quality is worlds better than the Pro Scan.

But the true benefit of the Pocket PC Camera is not the portability, it's the software. Intel has packed in the mother of all software bundles, and it's hard not to be impressed. There's the standard *NetMeeting* from Microsoft, the TWAIN drivers, and MGI image editing programs, but there's also a self-timer program for timing snapshots, a video e-mail setup, a home page builder, an audio recorder, a movie making program, and a slew of other simple but gratifying programs. Anything you can dream of doing with a webcam is made possible by this incredible software bundle.

Intel has packaged a solid camera that, for the price, serves as both an excellent dedicated webcam and a point-and-shoot alternative for the hobbyist.

Creative Video Blaster WebCam Go Plus

Whatever complaints you may have about CMOS sensors, the one used in the WebCam Go Plus from Creative works beautifully. In the past, CMOS sensors were looked down upon because, while being cheaper than CCDs and consuming less power, they traditionally delivered inferior image quality. Thankfully, those days appear to be over, since the CMOS used in the WebCam Go Plus is capable of capturing 16.7 million colors at 640x480 resolution, and does so without skimping on image quality.



The weird and somewhat bulky design of Creative's WebCam Go Plus is a trade-off for arguably the best picture quality of this group.

Like the Intel camera, the Go Plus can be separated from its USB cable for on-the-go digital camera action. It offers an auto-focus lens, 8MB of onboard memory (6MB dedicated to storing images and 2MB for voice data storage), the ability to record voice annotations, an audible shutter switch confirmation, and the option of time-delayed shots so you can hop in the picture yourself. Impressive, eh?

Two AAA batteries will get you roughly 275 shots from the Go Plus, making it eminently portable. But while its design is supposed to be optimized for travel, we found it to be just too big for pockets and awkward to hold when using it as a portable camera. We missed the simple and intuitive design of the Intel camera—we also missed the tripod mount that is included with both the Intel and Philips cameras. We also would have liked a flash and more software that utilized the webcam's potential, such as a picture sharing application, a beefier photo editor, or maybe even an app for managing inventories of photos.

We have to admit that the CMOS sensor on the Go Plus offers the best color reproduction of the three cameras reviewed here. It didn't fade pictures or overexpose them in bright light, and while it did have a tendency to make images appear a tad dark when shot in low light conditions, this webcam still offers the sharpest detail. But its awkward design and chintzy software left us nonplussed. It's a package with potential, but in its current configuration, it skimps in one too many places.

—Geoffrey Visgilio

CREATIVE

PLUSES
- Best picture quality
- Dedicates 2MB of memory for voice annotation
- Time-delayed photo option

MINUSES
- No flash
- No tripod mount
- Awkward design
- Skimpy software package

PHILIPS VESTA PRO SCAN — 7
$130 | Philips
www.philips.com

INTEL POCKET PC CAMERA — 9
$150 | Intel
www.intel.com | 800.538.3373

CREATIVE VIDEO BLASTER — 7
$130 | Creative
www.creative.com | 877.653.6227

CAM QUALITY

PHILIPS	INTEL	CREATIVE
This shot shows signs of an icky yellow, the blues are oversaturated, and the entire frame is overexposed.	Although the detail is pretty dead-on in this shot, we did experience fading and washed-out whites.	CMOS ain't too shabby here; we have solid color, decent light pickup, and good skin tone all around.

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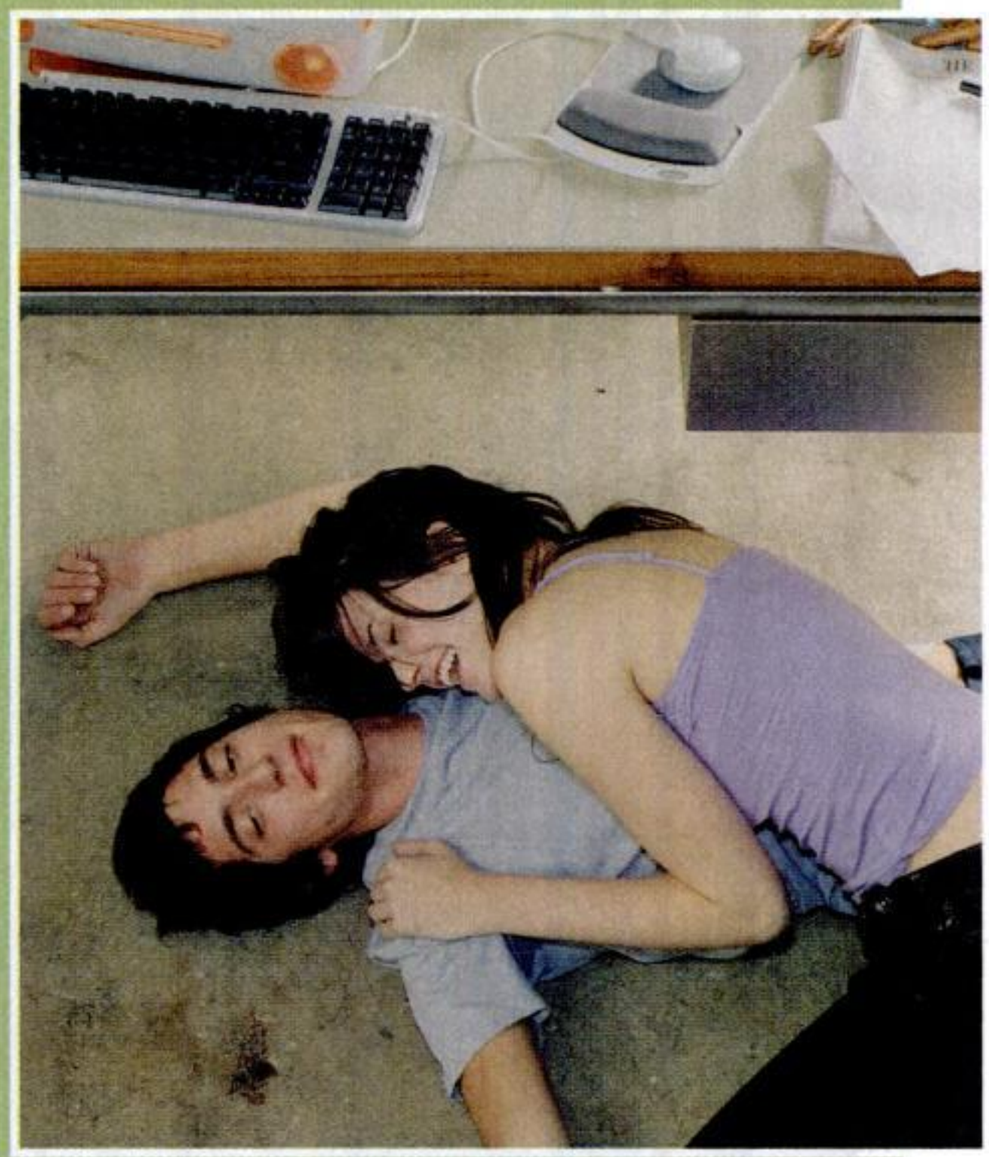
work.life.style.



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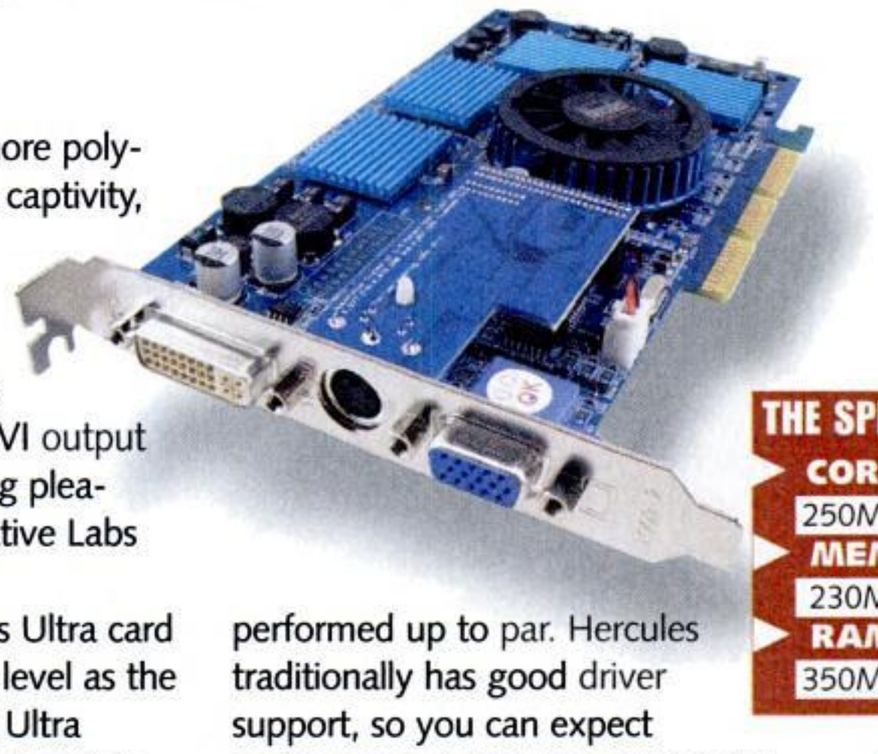
Hercules 3D Prophet II Ultra

IT'S THE BEST, JERRY—THE BEST!



The Hercules 3D Prophet II Ultra is one of the fastest videocards money can buy, eclipsed only by Creative Labs' Annihilator II Ultra—just barely. Like the Creative Labs flagship card, which we reviewed in November, the Hercules card is based on nVidia's GeForce2 Ultra chipset. Not surprisingly, the Hercules 3D Prophet II delivers all the outlandish frame rates we've come to expect from Ultra-based boards.

The "Ultra-class" cards don't suffer from the same performance handicaps that plague other videocards, thanks to their blazing fast 230MHz DDR SDRAM (up from 166MHz in standard GeForce2s) and hopped-up 250MHz core speed. The Prophet II Ultra uses its methamphetamine memory and fast clock speed to move more polygons than any videocard in captivity, including the Radeon and the Geforce2 GTS. The Prophet II Ultra isn't a bare reference board either. This card includes both a DVI output and TV-out for your viewing pleasure (features that the Creative Labs product lacks).

Surprisingly, the Hercules Ultra card didn't perform at the same level as the Creative Labs Annihilator 2 Ultra reviewed in November. The Prophet, using prerelease drivers, showed benchmark scores almost 10 percent slower than the Annihilator in *Quake III Arena* and *SYSmark*. Luckily for Hercules, the problem doesn't appear to be with the silicon but with the drivers. When we installed nVidia's 6.31 reference drivers, the Prophet performed up to par. Hercules traditionally has good driver support, so you can expect performance to improve with new driver releases, or you can simply use the reference drivers without losing any functionality.

The Hercules 3D Prophet II Ultra is the card to buy if you want ultimate frame rates along with DVI and TV-out support (for a $30 premium).

—Will Smith

THE SPECS

CORE SPEED
250MHz

MEMORY SPEED
230MHz DDR SDRAM

RAMDAC
350MHz

PLUSES
- Fastest card around
- DVI-output
- Ultimate bragging rights
- 1600x1200 gaming

MINUSES
- Costs as much as a cheap PC

RAW DATA

Q3A Demo 001	Q3A Quaver	3DMARK 16-bit	3DMARK 32-bit	SYSMARK	MDK2	EXPENDABLE
84.7	87.8	91.2	80.2	589	104.2	75

MAXIMUM PC VERDICT 9

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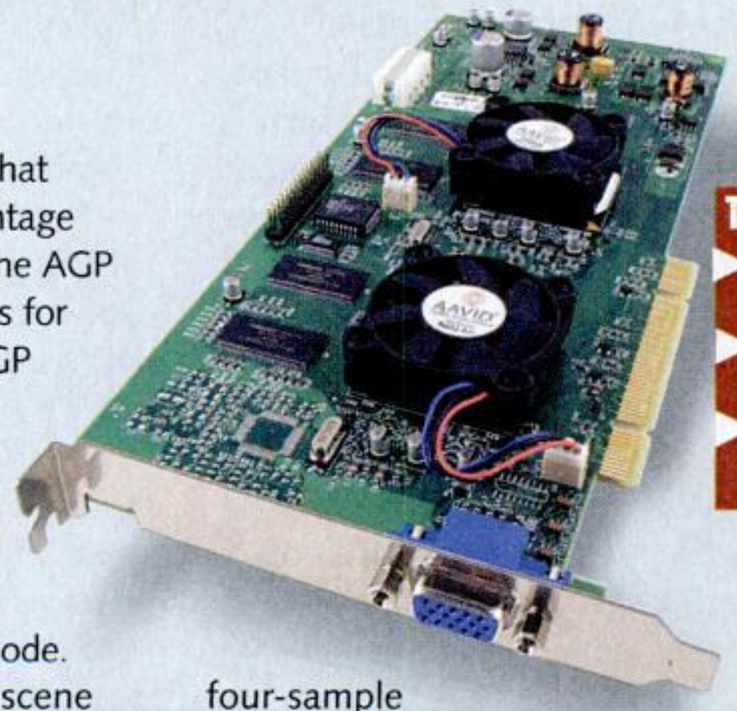
www.hercules.com | 877.484.5536

3Dfx Voodoo5 5500 PCI

THE ONLY GAME IN TOWN



The PCI videocard market has been bleak for the past few years, and it's not going to get better anytime soon. AGP is the port of choice these days, but if you're stuck with an OEM system that has onboard video, no AGP slot, and no other way to upgrade, there's hope in the Voodoo5 5500 PCI. If you read our review in August of the AGP version of the 5500, you know everything there is to know about this card—they're essentially the same part.

At the heart of the 5500 lies a pair of VSA-100 chips. Through the magic of programmable Scan Line Interleave (SLI), the work of rendering scenes is evenly divided between the two chips. It should be noted that the presence of two VSA-100 chips on the AGP version of the card prohibits that version from taking full advantage of the advanced features of the AGP bus (the AGP spec only allows for one chip). So, the PCI and AGP version of 5500 are really, really, similar, with the only notable difference being that the AGP version runs in PCI 66MHz mode, while the PCI version runs in PCI 33MHz mode.

The Voodoo5 offers full-scene anti-aliasing (FSAA), which removes jaggies from OpenGL and Direct3D titles. This technology is of limited use in first-person shooters, but in flight sims and racing games, the visual quality boost is impressive. The Voodoo5 5500 is still the only game in town when it comes to four-sample FSAA, and the effect it creates is truly beautiful, surpassing the two-sample FSAA that other cards provide.

If you need a PCI videocard, the Voodoo5 5500 PCI is the only card we can heartily recommend.

—Will Smith

THE SPECS

CORE SPEED
166MHz

MEMORY SPEED
166MHz SDR SDRAM

RAMDAC
350MHz

PLUSES
- Fastest PCI available
- 4x FSAA
- Two VSA-100 chips

MINUSES
- Requires extra power connector
- Slower than AGP cards
- No hardware T&L

RAW DATA

Q3A Demo 001	Q3A Quaver	3DMARK 16-bit	3DMARK 32-bit	SYSMARK	MDK2	EXPENDABLE
54.2	48.2	42.1	31.0	567	67.9	64.4

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Hard Drive Imaging Imbroglio

CLONING ISN'T JUST FOR SHEEP ANYMORE

Whenever there's a meltdown in the Lab, we thank the PC tiki gods for hard drive imaging software. After troubleshooting the cause of the meltdown, we grab a pristine image of our test machine's hard drive from a separate, secure partition, and—voila!—we start fresh with a clean slate.

If you're not the safe-and-secure type, you should be. Drive imaging utilities let you create and manage partitions and construct exact, sector-by-sector copies of your hard drive in case you do something stupid—like install a Microsoft Beta OS. To find out which cloning program is top dog, we gathered the three major players and pitted them against each other in a three-way brawl.

GHOST

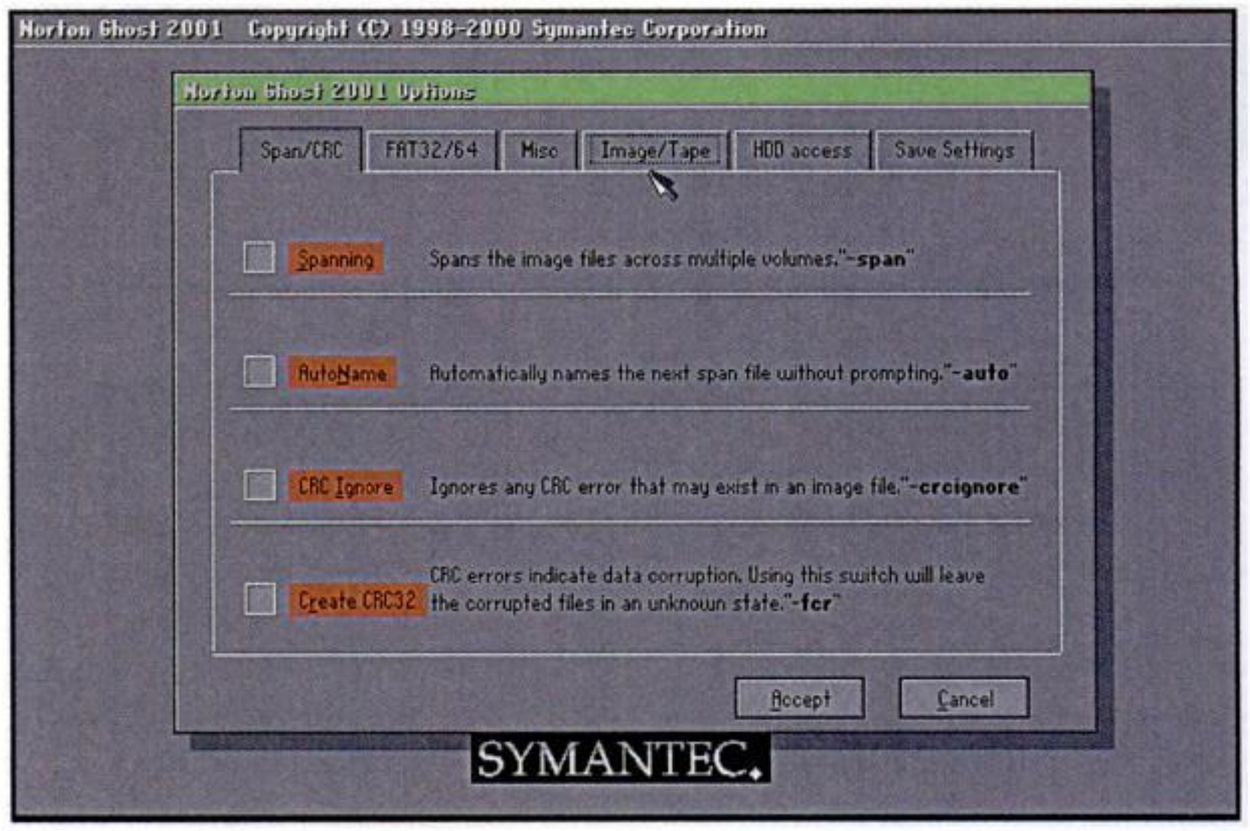
PLUSES
- Very configurable
- Support for a range of OS and media
- Good compression

MINUSES
- Antiquated interface
- Must run under DOS
- Relatively slow

Norton Ghost 2001

Developed (and still maintained for Symantec) by Ghost Software in New Zealand, this disk cloning product was among the first to appear back in 1996. And, like a hand-crafted Italian loafer—which no *Maximum PC* staffer has ever worn, by the way—*Ghost* is getting better with age.

Ghost 2001 is the "personal edition" of a larger corporate package and is intended for individual or small business use. As such, it lacks the ability to simultaneously multicast images to multiple network computers. Otherwise, *Ghost 2001* is very similar to its corporate sibling. The utility includes image file encryption and password protection (which might prove useful if you want to protect your loansharking records from the local Barney Fife), along with more esoteric, but nonetheless welcome, options. Among these is



***Ghost* offers plenty of features in its GUI, but to get full benefit from the program, you have to check out the entire range of command-line switches in DOS.**

the option to script a series of commands for *Ghost* to execute in sequence during the imaging process. This can be a boon to more advanced users who want to perform an automated series of backup, restore, and testing operations.

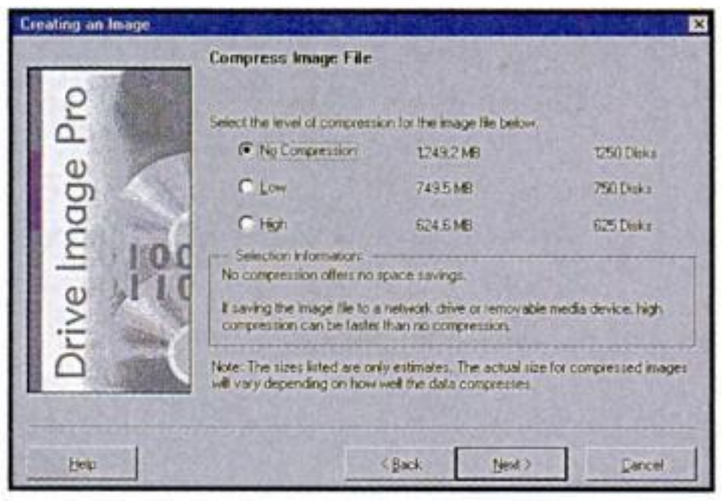
The *Ghost* package is comprised of four applications. The drive cloning program itself is a native DOS app—because restoring an OS after a crash cannot logically be accomplished within the OS itself. You also get the DOS-based *GDISK*, a straightforward partitioning/formatting tool; the Windows-based *Boot Wizard*, which creates a boot disk; and *Ghost Explorer*, a Windows Explorer-type program for image files. While all these are solid applications, we question whether it's necessary for all of them to be separate. Surely, some of these utilities could be integrated for easier operation.

Unfortunately, user-friendliness isn't a feature of *Ghost 2001*. Developed when graphical platforms were all the rage but Windows had yet to become a standard, *Ghost*'s DOS-based graphical interface is non-Windows compliant. A number of its features—such as the ability to display physical drive attributes, exclude wildcard-designated files during selective file copying, and employ all nine levels of compression—aren't even inside the GUI. In order to access these commands, they must be run as command-line switches while loading the software from DOS.

Even without choosing to run these options, *Ghost 2001* is a chore. Commands are no more descriptive than "Local," "Disk," and "From Image." The interface is nonstandard—you hit [CTRL+C] to cancel a selection, not [ESC] or a CANCEL button. Help is extremely limited—just a sentence of description for the various switches that the software has chosen to include. If you make an error, *Ghost* notifies you of that fact, without explaining much else.

To its credit, *Ghost* works with cool efficiency once you put in considerable quality time with the manual. Also, it can run successfully from a floppy in a 386SX with 8MB RAM. We tested it on both a 486 and a Pentium II 450. In both cases, it executed all operations flawlessly.

If you're an extreme power user, *Ghost* can't be beat for streamlined effectiveness. For most users, however, *Ghost*'s interface will prove too cryptic and its options too scant.


Creating an Image
Compress Image File
Drive Image Pro
Select the level of compression for the image file below:
No Compression
1249.2 MB
1250 Disks
Low
749.5 MB
750 Disks
High
624.6 MB
625 Disks
Selection Information:
No compression offers no space savings.
If saving the image file to a network drive or removable media device, high compression can be faster than no compression.
Note: The sizes listed are only estimates. The actual size for compressed images will vary depending on how well the data compresses.
Help
< Back
Next >
Cancel

***Drive Image* provides excellent help in a Windows-like DOS environment.**

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Drive Image 4.0

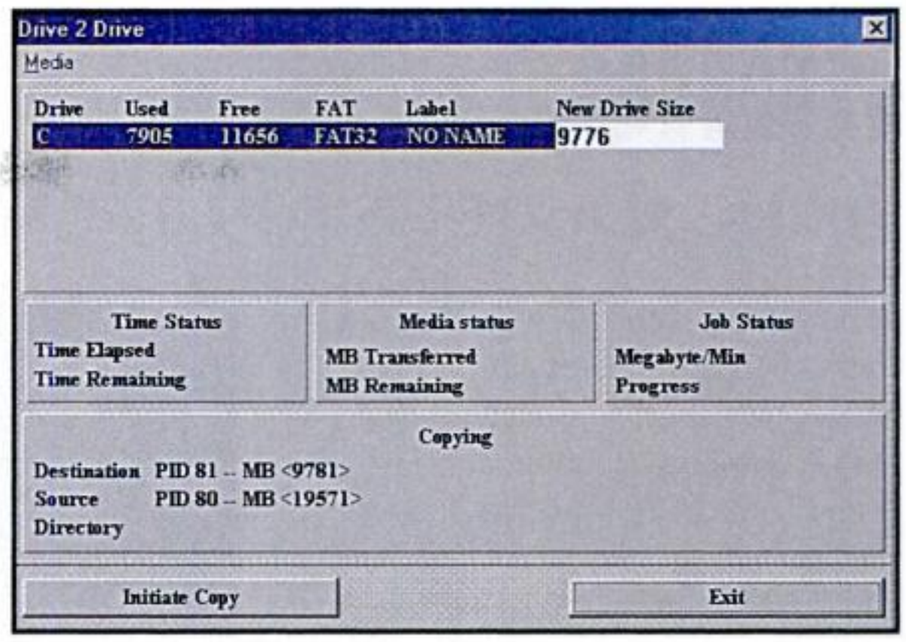
The main competition for *Norton Ghost* over the last several years has come from PowerQuest's *Drive Image*. Both applications offer basic and advanced cloning options, including CD-R/RW and removable magnetic media support, image spanning across multiple discs, and Windows 2000/ME compatibility.

Like *Ghost*, *Drive Image* is bundled with several related applications. Its Windows-based *File Editor* is another Windows Explorer clone, designed to manipulate *Drive Image*-created data. *Drive Image Scheduler* uses Windows Task Manager to remind you at user-defined intervals of the need for a backup (in other words, a perfectly useless little utility). But *Drive Image* easily surpasses *Ghost* with the inclusion of *Datakeeper*, a TSR that tracks changes to a specified drive and copies new and altered files or folders to a local hard disk, network drive, second partition, or removable media. The program waits for a time when you're using minimal Windows resources and then automatically begins its incremental backups. *Datakeeper* is a godsend, eliminating the need for all but the occasional lengthy, full drive/partition cloning sessions. The fly in the ointment is that *Datakeeper* itself consumes an additional six percent of your computer's resources while it resides in the background. Still, given its advantages, those are resources well spent.

Drive Image's DOS-based graphical interface emphasizes ease of use (in stark contrast to *Ghost*) and mirrors the look and feel of Windows. Extensive help is available as well, although this raises the application's requirements a bit beyond *Ghost*'s, but only up to a paltry 16MB RAM (with 32MB preferred) and a 486DX.

So *Drive Image* is the bomb, right? Actually, when comparing application speed and compression ability, it pales in comparison to *Ghost 2001*. For compression levels, *Drive Image* claims solid compression figures on its summary screen. But selecting the most-compressed algorithm never produced results remotely equaling expectations. For instance, *Drive Image* would claim a nearly 2:1 ratio and deliver something closer to 4:3. *Ghost* achieved better compression rates, although cloning was considerably slower than image restoration, due to the program's defragmenting of files before compression.

In balance, *Drive Image* works very slowly, but it works competently and consistently. And its intuitive interface makes operation a pleasure. It's more full-featured than the other programs in this roundup, and this shows in its sluggish performance.



Unlike the other applications in this roundup, *Drive2Drive* is able to operate within Windows rather than DOS.

Drive2Drive

Drive2Drive is certainly the underdog in this roundup, but since it's not meant to be an all-in-one solution, it stands on its own as the "low-cost alternative." Costing only 20 smackers, this proggie is extremely streamlined, which we found to be both good and bad.

Unlike the competition, *Drive2Drive* runs from within Windows, and when we say run, we mean *run*. This application achieves cloning speeds that far outpace the others—two to four times as fast, depending upon the file types, partition sizes, and what-have-you that are being duplicated. The speed differential between the other cloning apps and *Drive2Drive* is doubtless due to inherent limitations in DOS-available memory and resources. Since *Drive2Drive* is a native Windows app, it's much more efficient in this regard. It also doesn't defragment drives or use compression; it simply makes an exact copy of a drive or partition. The downside is that *Drive2Drive* requires more destination drive space—twice as much as *Ghost*.

Another nice feature of this app is that it requires no installation. You merely execute the EXE file on the *Drive2Drive*'s floppy disk, and the program analyzes your drives. In a similar vein, you don't have to manually reset partition size when cloning from, say, a 1GB to 5GB partition. *Drive2Drive* handles that for you.

Of course, this kind of simplicity comes with its own price tag, in the form of fewer options and poor adaptability. We've already hinted at one limitation: Since *Drive2Drive* makes an exact clone, it can't span a partition or hard drive across multiple removable storage disks. The utility also can't merge partitions or perform CD-R/RW spanning. Nor does it currently support HPFS or NTFS—High Performance File System and New Technology File System, respectively (a.k.a. OS/2 and Windows NT substitutes for the DOS-based File Allocation System still used under Windows 95/98).

Our personal experience with *Drive2Drive* was like a roller coaster ride. Sometimes it performed flawlessly, and other times it coughed up the message, "This system has one drive with one physical drive. There is no place to copy to!" The program would then perform a minor lockup.

Speed and ease of use are important qualities, and *Drive2Drive* supplies these in spades. But its narrow range of features and performance-related difficulties make this product a dubious choice at best, especially considering that your precious data may be at stake.

—Barry Brenesal

DRIVE IMAGE 4.0

PLUSES
- Excellent interface
- TSR backs up file changes on the fly
- Support for a range of OS and media

MINUSES
- Poor compression
- Must run under DOS
- Relatively slow

DRIVE2DRIVE

PLUSES
- Extremely fast copying
- No installation required
- Simple interface

MINUSES
- Very limited configuration options
- Inconsistent performance
- Stability issues

NORTON GHOST 2001 — 8
$70 | Symantec Corporation
www.symantec.com
408.253.9600

DRIVE IMAGE 4.0 — 9
$70 | PowerQuest
www.powerquest.com
801.437.8900

DRIVE2DRIVE — 6
$20 | Future Systems Solutions (developer); Higher Ground Software (publisher)
www.fssdev.com
770.956.7276

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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Rune

VIKING SLASHER IS FUN BUT FRUSTRATING

Rune attempts to follow in the footsteps of Raven's *Heretic II*, but ultimately falls short of matching that game's gripping storyline and fast-paced combat. But just like Raven's classic, *Rune* is a first-person action game played from a third-person perspective. Although it's light on story and clumsy in its pacing, *Rune* looks amazing, thanks to its modified *Unreal Tournament* graphics engine. And the Viking theme offers a refreshing twist on the genre with its focus on melee combat rather than projectile-based warfare.

PLUSES
- Beautiful mods to the *UT* engine
- Brutal melee combat
- Refreshing Viking setting

MINUSES
- Uninspired level design
- Poor story and pacing
- Boring opening third
- Not enough multiplayer

THE SPECS

3D CARD SUPPORT
Direct 3D

3D AUDIO SUPPORT
EAX, A3D, DirectSound

MULTIPLAYER
LAN, TCP/IP

TOTAL PLAYERS
32

Gameplay

The game's main character is a Viking named Ragnar who has become a man and is now ready to join the warriors of his village—just in time to watch them all die at the hands of the bad guys. Naturally, being a rough-and-tumble Viking, Ragnar survives and is charged with the noble mission of protecting neighboring villages' sacred artifacts from would-be attackers. That's when the game begins in earnest. Sort of.

In the first portion of the game, you find yourself swimming around aimlessly underwater, admiring the absolutely gorgeous water effects, sunken ships, and horribly dangerous giant fish. Occasionally you surface and do battle with giant crabs and goblins, but mostly the first couple hours of the game imitate *Tomb Raider* in the most boring way possible. Finally, you find a castle that leads to the Norse realm of the dead, and

The dynamic lighting and character models are impeccably rendered in *Rune*, which uses the *Unreal Tournament* engine.

Being a bloodthirsty Viking should be fun, but *Rune* has too many crabs to fight and too slow a pace.

that's when the ass-kicking starts. Sort of. Once again, the pacing is tedious, with infrequent combat against the exact same enemies, over and over and over. The game continues at this sedate pace for way too long, with each level having its own creature du jour. Along the way, a giant head appears to tell you what's happening, since there's little chance of you figuring it out on your own.

Technology

While *Rune*'s gameplay is ultimately disappointing, the real achievement is in the graphics. The game throws the *UT* engine into third-person perspective, and, according to Human Head Studios, the character models are composed of a whopping 14,000 polygons. For comparison, a *Quake III* model has about 1,000 polygons. Equally impressive is the skeletal animation system Human Head added to the *UT* engine, which allows the characters to lip-synch speech during cutscenes or swing their axes convincingly in combat. Further, the dynamic lighting is well done (Ragnar holding a torch is a sight to behold), animations are fluid, and "pain skins" are bloody and realistic. Multiplayer is refreshingly different, in that you're running around with melee weapons rather than rocket launchers, but close combat requires a really low ping. Unfortunately, the game only includes Deathmatch and Team Deathmatch. Where are the other cool *UT* modes, such as Domination Assault and Capture the Flag?

What prevents the game from being a classic is its poor pacing. Despite its good looks, the first quarter of the game has you fighting crabs and weird worm monsters and spelunking, which isn't very thrilling. In fact, it sucks. Later, when you leave the caves behind and start to mix it up with skeletons and much more threatening critters, you begin to feel like a true Viking on a murderous rampage. But shouldn't getting there be half the fun?

—Andrew S. Bub

RUNE

TECHNOLOGY	9
GAMEPLAY	5

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No One Lives Forever

IT'S SHAGADELIC, BABY

Rarely do we receive a game that we'll unabashedly admit to spending more than 40 hours playing. Even after spending too many hours playing *No One Lives Forever*, we were sorry to see it end. This first-person shooter is more fun than any game we've played in recent memory.

In *NOLF*, you play as secret agent Cate Archer, an operative for a circa-1960s British spy agency, assigned to save the world from a mean organization called H.A.R.M. Miss Archer is the typical femme fatale—drop-dead gorgeous, extremely lethal, and armed with wit and weaponry.

PLUSES
- Awesome story
- Cool animation
- Great AI
- Hilarious writing
- Superb scripting

MINUSES
- LithTech 2.5 looks dated
- Too many stealth missions
- Only four multiplayer maps

Gameplay

While the individual gameplay elements of *NOLF* are almost entirely derivative—originally appearing in games such as *Goldeneye*, *Soldier of Fortune*, and *Deus Ex*—Monolith has combined them superbly. Gameplay ranges from the classic run-and-gun to stealth espionage, covering everything in between. Tasks such as pulling a parachute jacking while plummeting to earth or running over enemies with your snowmobile crop up throughout the game, creating a fun mix of missions. There's nothing really innovative here, but, with a few exceptions, every level is beautifully executed.

The one flaw in an otherwise perfect game lies in the excessive number of stealth missions. These often frustrating levels force you to avoid contact with guards and cameras, which leaves almost no room for error, necessitating many a reload.

The splendid animation allows for enemies standing near a ledge or stairway to tumble off when pumped full of lead.

***No One Lives Forever* is chock-full of violence, over-the-top weaponry, and more humor than any game in recent memory.**

These levels slow the game's pace considerably, and the parameters that set off alarms or alert guards seem ever-changing.

Technology

NOLF is full of technical wizardry—skeletal animation, environment mapping, tactical squad-based AI, recoil animations, reciprocal environmental damage, and DirectMusic, to name just a sampling. Although *NOLF* doesn't contain any truly groundbreaking technology, it's got everything that's expected of a triple-A title.

The most interesting component of the game is that it uses the newest version of the LithTech engine, version 2.5. It's the first LithTech engine to support 32-bit color, but, unfortunately, it looks dated compared to newer games based on other engines.

The skeletal animation system in *NOLF* allows detailed models with interchangeable sections, lending great variety to the characters' appearance throughout the game. Location-based damage is also implemented and is tied to character animation, so an enemy's reaction to being shot depends on where he takes the bullet. The effect is very realistic, evoking *Soldier of Fortune* flashbacks.

The enemies are both clever *and* amusing. In combat they act intelligently but also yell things such as "I hate it when they use real bullets!" as they dive for cover. It's hilarious when you sneak up on a pair of guards at their post who are chatting about TV, their co-workers, or other evil organizations. If you blow your cover, they attack as a team, lay down suppressing fire, and lob grenades at you while they take cover and reload their weapons.

When we were done with the game, we wanted more. It's a game that any FPS fan must play.

—Will Smith

THE SPECS

3D SOUND SUPPORT
DirectMusic

3D SUPPORT
Direct 3D

NETWORK SUPPORT
Internet and LAN

TOTAL PLAYERS
16

NO ONE LIVES FOREVER

TECHNOLOGY 8

GAMEPLAY 9

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EPoX EP-MVP3G5	MB5405	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	2 Yrs.	$110	$190	$215	$170
FIC VA-503+	MB5211	VIA Apollo MVP3	1024	512	2	4	Award			3	3	1	Baby AT	1 Yr.	$79	$159	$184	$139
Shuttle HOT-591P	MB5611	VIA Apollo MVP3	512	256	2	2	Award			3	3	1	Baby AT	1 Yr.	$80	$160	$185	$140
Tyan S1590S Trinity 100AT	MB5006	VIA Apollo MVP3	1024	384	3	2	Award			4	4	1	Mini AT	3 Yrs.	$111	$191	$216	$171

Slot A

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Athlon™ 850MHz	w/AMD Athlon 900MHz	w/AMD Athlon 950MHz	w/AMD Athlon 1000MHz	w/AMD Athlon 1100MHz	w/AMD Athlon 1200MHz
ABIT KA7-100	MB7502	VIA Apollo KX133	2048	4	Award	200/133	UltraDMA/100	6	1	1	ATX	1 Yr.	$165	$365	$395	$455	$505	$605	$745
Asus K7V	MB7703	VIA Apollo KX133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr.	$145	$345	$375	$435	$485	$585	$725
EPoX EP-7KXA	MB7850	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	5	1	1	ATX	2 Yrs.	$120	$320	$350	$410	$460	$560	$700
Shuttle AI61	MB7901	AMD-750	768	3	Award	100	UltraDMA/66	5		1	MicroATX	1 Yr.	$87	$287	$317	$377	$427	$527	$667
Tyan S2380 Trinity K7	MB7000	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	6	1	1	ATX	3 Yrs.	$109	$309	$339	$399	$449	$549	$689

Socket A

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Duron™ 700MHz	w/AMD Duron 750MHz	w/AMD Duron 800MHz	w/AMD Athlon™ 850MHz with Enhanced Cache	w/AMD Athlon 900MHz with Enhanced Cache	w/AMD Athlon 950MHz with Enhanced Cache	w/AMD Athlon 1000MHz with Enhanced Cache	w/AMD Athlon 1100MHz with Enhanced Cache	w/AMD Athlon 1200MHz with Enhanced Cache
ABIT KTV	MB7503	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	6	1	1	ATX	1 Yr.	$155	$250	$270	$295	$355	$385	$445	$495	$595	$735
ABIT KTV-RAID	MB7504	VIA Apollo KT133	1536	3	Award	200/133	DMA/100 RAID	6	1	1	ATX	1 Yr.	$179	$274	$294	$319	$379	$409	$469	$519	$619	$759
ASUS A7V	MB7704	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/100	5		1	ATX	1 Yr.	$169	$264	$284	$309	$369	$399	$459	$509	$609	$749
EPoX EP-8KTA+	MB7852	VIA Apollo KT133	768	3	Award	200/133	UltraDMA/66	6	1	1	ATX	2 Yr.	$127	$222	$242	$267	$327	$357	$417	$467	$567	$707
FIC AZ11	MB7402	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr.	$115	$210	$230	$255	$315	$345	$405	$455	$555	$695
Microstar K7T Pro	MB7203	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr.	$137	$232	$252	$277	$337	$367	$427	$477	$577	$717
Tyan S2390 Trinity KT	MB7001	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	6	1	1	ATX	3 Yr.	$137	$232	$252	$277	$337	$367	$427	$477	$577	$717

Slot 1

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	168-pin RIMM Sockets	Flash BIOS	Integrawed Audio	Integrawed Controller	PCI Slots	ISA Slots	AGP Slot	Formaw	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® 667 256K OD 133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 850 256K OD 100MHz FSB	w/Intel Pentium III 933 256K OD 133MHz FSB	w/Intel Pentium III 1000 256K OD 133MHz FSB	w/Dual Intel Pentium III 800 256K OD 100MHz FSB	w/Dual Intel Pentium III 850 256K OD 100MHz FSB
ABIT BE6-II	MB6508	Intel 440BX	768	3		Award		UltraDMA/66	5	1	1	ATX	1 Yr.	$142	N/A	N/A	$382	$442	N/A	N/A	N/A	N/A
ABIT BX133-RAID	MB6513	Intel 440BX	768	3		Award		DMA/100 RAID	5	1	1	ATX	1 Yr.	$146	N/A	N/A	$386	$446	N/A	N/A	N/A	N/A
ABIT VT6X4	MB6510	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$104	$294	$319	$344	$404	$534	$679	N/A	N/A
ASUS P2B-DS (Dual)	MB6707	Intel 440BX	1024	4		Award			4	2	1	ATX	1 Yr.	$509	N/A	N/A	$749	$809	N/A	N/A	$989	$1109
ASUS P3V4X	MB6723	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	6	1	1	ATX	1 Yr.	$126	$316	$341	$366	$426	$556	$701	N/A	N/A
Intel L440GX+ (Dual)	MB6917	Intel 440GX	2048	4		Intel/Phoenix		Adaptec 2-Ch U2W	6	1		ATX	3 Yrs.	$499	N/A	N/A	$739	$799	N/A	N/A	$979	$1099
Intel SE440BX-2 "Seattle"	MB6921	Intel 440BX	768	3		Intel/Phoenix			4	2	1	ATX	3 Yrs.	$120	N/A	N/A	$360	$420	N/A	N/A	N/A	N/A
Shuttle AV64	MB6309	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$89	$279	$304	$329	$389	$519	$664	N/A	N/A
SuperMicro PIIIDR3 (Dual)	MB6157	Intel 840	4096	4		AMI	AC-97	Adaptec Ultra3/160	6		1	ATX	1 Yr.	$617	$807	$832	$857	$917	$1047	$1192	$1097	$1217
SuperMicro P6DGU (Dual)	MB6122	Intel 440GX	2048	4		AMI		Adaptec U2W	5	2	1	ATX	1 Yr.	$485	N/A	N/A	$725	$785	N/A	N/A	$965	$1085
SuperMicro P6SBA	MB6120	Intel 440BX	768	3		AMI			4	3	1	ATX	1 Yr.	$103	N/A	N/A	$343	$403	N/A	N/A	N/A	N/A
SuperMicro P6SBU	MB6128	Intel 440BX	1024	4		AMI		Adaptec U2W	4	3	1	ATX	1 Yr.	$343	N/A	N/A	$583	$643	N/A	N/A	N/A	N/A
Tyan S1834 Tiger 133 (Dual)	MB6020	VIA Apollo Pro 133A	2048	4		Award		UltraDMA/66	6	1	1	ATX	3 Yrs.	$159	$349	$374	$399	$459	$589	$734	$639	$759

Socket 370

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video or IDE/SCSI Controller	PCI Slots	ISA Slots	AGP Slot	AMR or CNR Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Celeron™ 600 128K OD 66MHz FSB	w/Intel Celeron 700 128K OD 66MHz FSB	w/Intel Celeron 733 128K OD 66MHz FSB	w/Intel Pentium® III 667 256K OD 133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 850 256K OD 100MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB	w/Intel Pentium III 933 256K OD 133MHz FSB	w/Intel Pentium III 1000 256K OD 133MHz FSB	w/Dual Intel Pentium III 800EB 256K OD 133MHz FSB
ABIT SE6	MB6512	Intel 815E	512	3	Award	Intel 815E	Intel 815E	6		1	1	ATX	1 Yr.	$157	$257	$267	$297	$347	$372	$397	$457	$457	$587	$732	N/A
ABIT SA6R	MB6514	Intel 815E	512	4	Award	Intel 815E	Intel 815E	6		1	1	ATX	1 Yr.	$183	$283	$293	$323	$373	$398	$423	$483	$483	$613	$758	N/A
ABIT VH6	MB6511	VIA Apollo Pro 133A	768	3	Award	AC-97		5	1	1	1	ATX	1 Yr.	$110	$210	$220	$250	$300	$325	$350	$410	$410	$540	$685	N/A
ABIT VP6 (Dual)	MB6515	VIA Apollo Pro 133A	2048	4	Award		IDE RAID	5		1		ATX	1 Yr.	$179	$279	$289	$319	$369	$394	$419	$479	$479	$609	$754	$659
ASUS CUBX	MB6726	Intel 440BX	1024	4	Award	AC-97		6	1	1		ATX	1 Yr.	$149	$249	$259	$289	N/A	N/A	$389	$449	N/A	N/A	N/A	N/A
ASUS CUC2 (uses RDRAM)	MB6730	Intel 820E	1024	2	Award			6		1	2	ATX	1 Yr.	$219	$319	$329	$359	$409	$434	$459	$519	$519	$649	$794	N/A
ASUS CUSL2	MB6727	Intel 815E	1536	3	Award	Intel 815E	Intel 815E	5	1	1	1	ATX	1 Yr.	$172	$272	$282	$312	$362	$387	$412	$472	$472	$602	$747	N/A
ASUS CUR-DLS (Dual)	MB6728	ServerWorks LE	4096	4	Award		RAGE-XL	7				ATX	1 Yr.	$599	$699	$709	$739	$789	$814	$839	$899	$899	$1029	$1174	$1079
ASUS CUV4X	MB6725	VIA Apollo Pro 133A	1536	3	Award	AC-97		5	1	1	1	ATX	1 Yr.	$131	$231	$241	$271	$321	$346	$371	$431	$431	$561	$706	N/A
EPoX EP-3VCA2	MB6856	VIA Apollo Pro 133A	768	3	Award	AC-97		5		1	1	ATX	2 Yrs.	$107	$207	$217	$247	$297	$322	$347	$407	$407	$537	$682	N/A
Intel D815EEA "Easton"	MB6922	Intel 815E	512	3	Award	Intel 815E	Intel 815E	5		1	1	ATX	3 Yrs.	$151	$251	$261	$291	$341	$366	$391	$451	$451	$581	$726	N/A
Shuttle AV14	MB6311	VIA Apollo Pro 133A	768	3	Award			5	2	1		ATX	1 Yr.	$89	$189	$199	$229	$279	$304	$329	$389	$389	$519	$664	N/A
Shuttle ME21	MB6312	Intel 815E	512	2	Award	Intel 815E	Intel 815E	3		1	1	Micro ATX	1 Yr.	$144	$244	$254	$284	$334	$359	$384	$444	$444	$574	$719	N/A
SuperMicro 370SEA	MB6140	Intel 810E	512	2	AMI	Intel 810E	Intel 810E	6	1		1	ATX	1 Yr.	$142	$242	$252	$282	$332	$357	$382	$442	$442	$572	$717	N/A
SuperMicro 370SSA	MB6143	Intel 815E	512	2	AMI	Intel 815E	Intel 815E	6		1	1	ATX	1 Yr.	$162	$262	$272	$302	$352	$377	$402	$462	$462	$592	$737	N/A
SuperMicro 370DLE (Dual)	MB6154	ServerWorks LE	2048	2	AMI			6	1			ATX	1 Yr.	$342	$442	$452	$482	$532	$557	$582	$642	$642	$772	$917	$822
SuperMicro 370DL3 (Dual)	MB6155	ServerWorks LE	2048	2	AMI		Ultra160	6	1			ATX	1 Yr.	$545	$645	$655	$685	$735	$760	$785	$845	$845	$975	$1120	$1025
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3	Award			6	1	1		ATX	3 Yrs.	$106	$206	$216	$246	$296	$321	$346	$406	$406	$536	$681	N/A

Slot 2

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	Integrated Controller	Integrated Networking	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® Xeon™ 550MHz 512K 100MHz FSB	w/Intel Xeon 550MHz 1M 100MHz FSB	w/Intel Xeon 550MHz 2M 100MHz FSB	w/Dual Intel Xeon 550MHz 512K 100MHz	w/Quad Intel Xeon 550MHz 512K 100MHz	w/Intel Xeon 700MHz 1M 100MHz FSB	w/Intel Xeon 700MHz 2M 100MHz FSB	w/Dual Intel Xeon 700MHz 1M 100MHz	w/Quad Intel Xeon 700MHz 1M 100MHz
SuperMicro S2DL3	MB6162	ServerWorks LE	4096	4	AMI			Adaptec Ultra160	Intel 82552	6	1		ATX	1 Yr.	$647	$1747	$2977	$4987	$2847	N/A	$2047	$2997	$3447	N/A
SuperMicro S2QR6	MB6190	ServerWorks HE	16384	16	AMI			Adaptec 2-Ch Ultra160	Intel 82559	8			SWTX	1 Yr.	$2799	$3899	$5129	$7139	$4999	$7199	$4199	$5149	$5599	$8399

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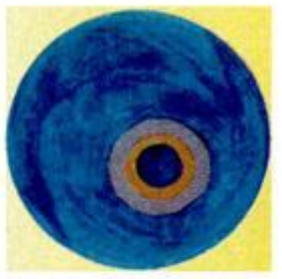

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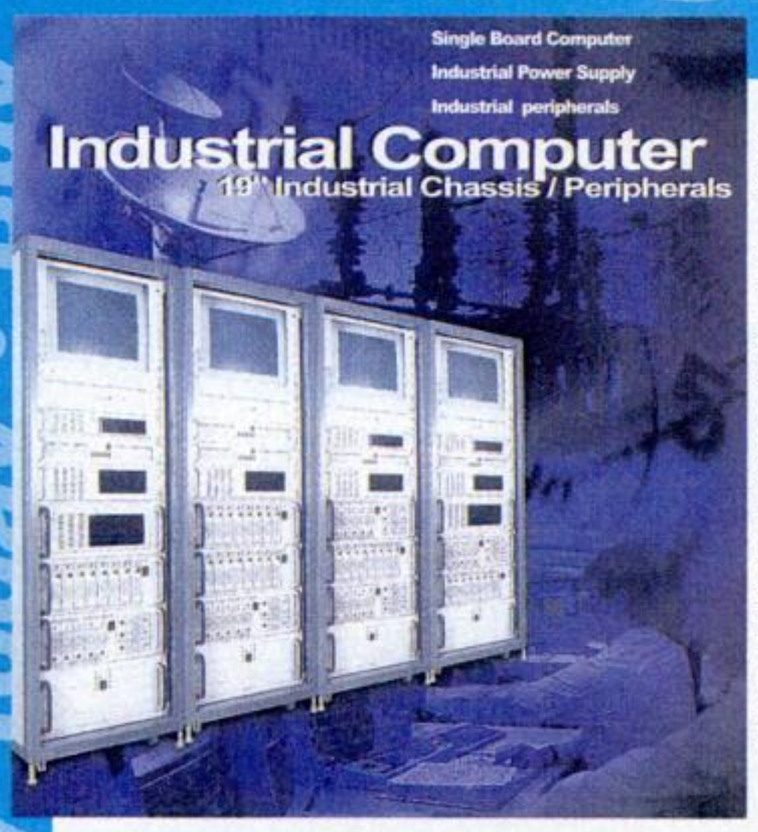

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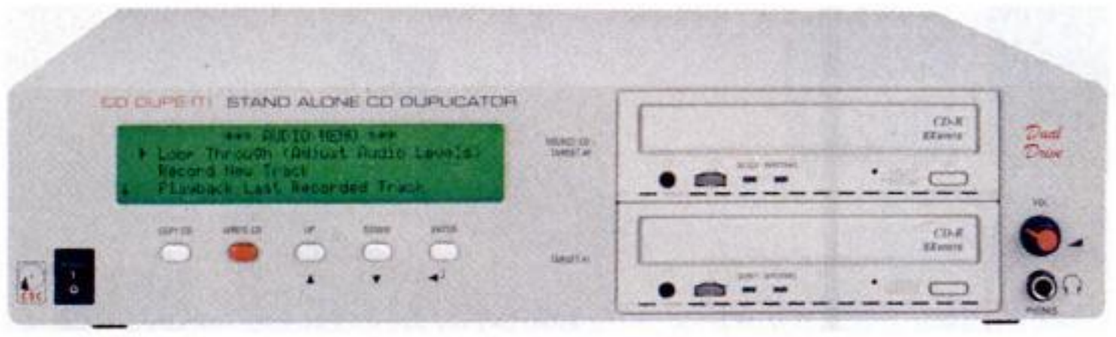

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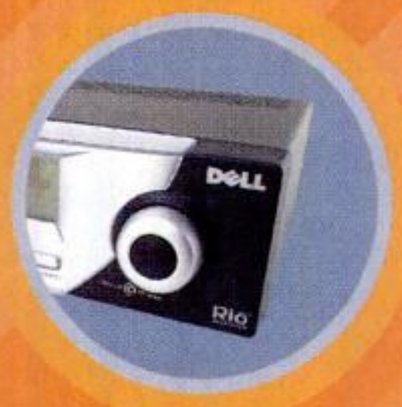

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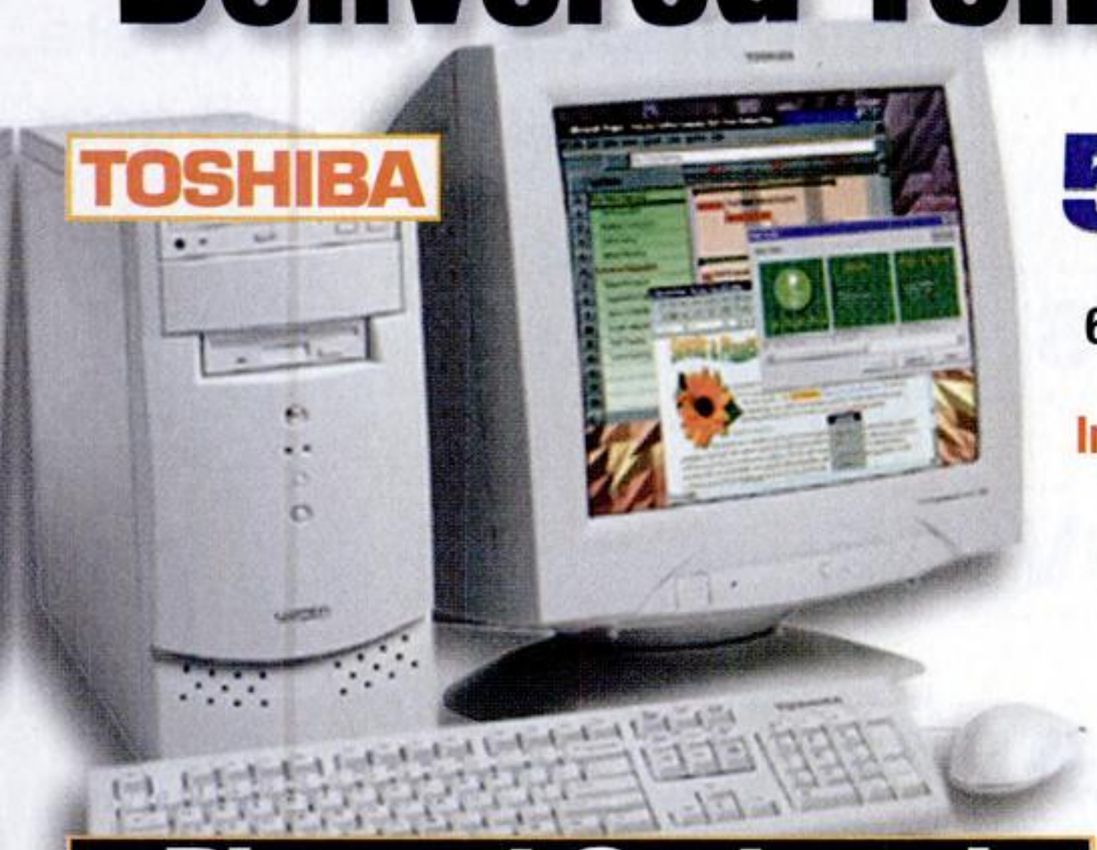

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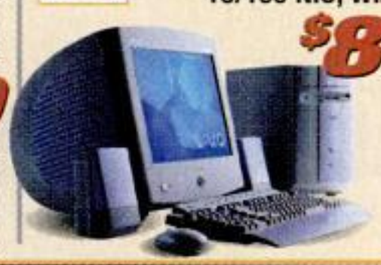

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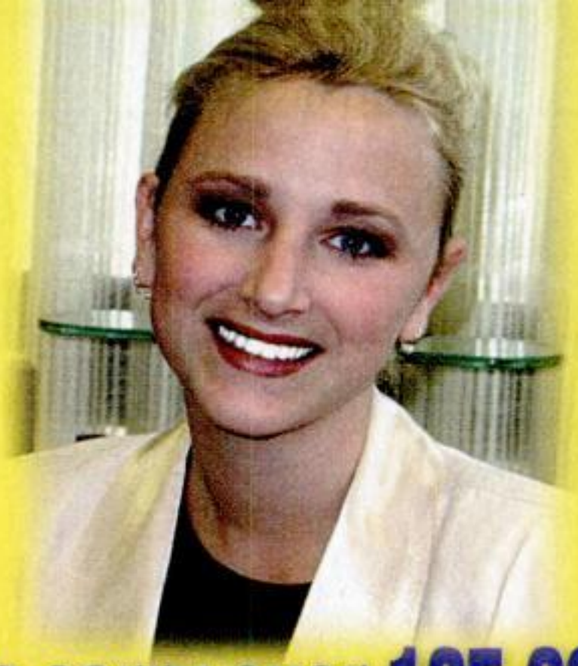

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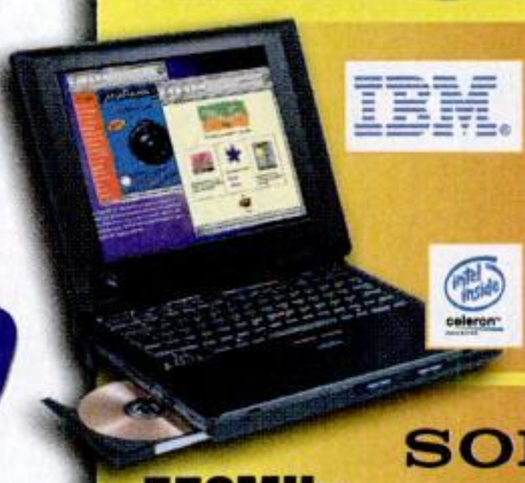

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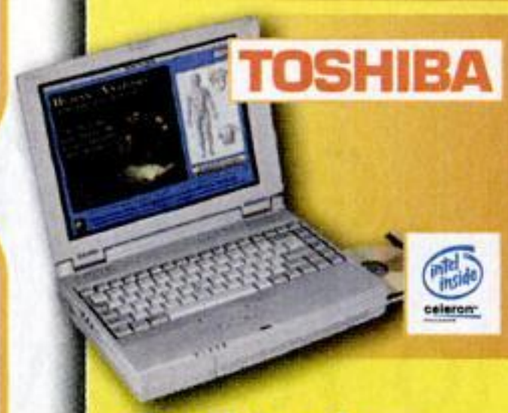

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The Daily Glitch

Apex of Accuracy, Paragon of Truth * Tuesday, January 2, 2001

This Day in History

Jan. 7, 1975: Ron Jomero announces 'Maipiñata'

Ron Jomero, the famed rock star/game developer, announces plans for an ambitious text adventure for the MITS Altair platform. "We're going to change the way people use a Teletype terminal." Jomero says. Maipiñata is scheduled for a Q1 1976 release date and should cost $10 in punched-tape and 8-inch disk versions.

Feb. 9, 1976: 'Maipiñata' Pushed Back

With the game's intended release date just days away, Jomero announces the game won't hit shelves until sometime in 1978, citing fundamental changes in the computer industry. Says Jomero, "With the release of Microsoft's BASIC computer language and the flourishing of the 'Video Display Unit,' we can move from straight, text-based gaming to lavish ASCII art. It should be well worth the wait!"

Aug. 21, 1982: 'Maipiñata' Shifting Gears

Explaining a missed Q2 1978 release date, Jomero says the Maipiñata team stopped development mid-stream in response to dramatic advancements in gaming technology. "Maipiñata is being re-vamped to include sound as well as graphics," says Jomero, "and is now being billed as a 'Side-Scrolling Graphical Adventure.'" Retail price is expected to be $20. The game should be available in Q1 1985.

Jan. 9, 1985: 'Maipiñata' Pushed Back Once Again

Jomero announces the further delay of Maipiñata. "Our company has re-organized," says Jomero. "We will now focus on products intended for store shelves. These products will bear price tags. We expect shoppers will see these price tags and interpret them as invitations to offer money for the products. If retailers accept the shoppers' offers, then the shoppers will be able to take the games home and play them for as long as they want. The sale of these so-called 'crappy games' should generate enough revenue for us to finish development of a 'real game,' namely Maipiñata."

Jomero poses with his devil-spawn.

Sept. 28, 1988: Jomero Releases Game

In a stunning move, Jomero releases a game. Most experts agree that it is not Maipiñata. Titled DJ Flymaster's Ultra Mix Challenge and developed for the Commodore 64 Platform, the game consists of a virtual turntable, the speed of which is manipulated with arrow keys. The game lacks a user's manual but includes loading instructions hand-written on a Saltine cracker. Still no word on when Maipiñata will be released.

Feb.1, 1991: Jomero LTD Now Inflated Ego Software

Jomero announces that his company will now be called Inflated Ego Software to better reflect how he feels about himself. And while release plans for Maipiñata are still unknown, Jomero insists they exist. "I wish everyone would stop bugging me!," he says. "You'll know when it's done because the sky will open up and Jesus Christ will return to earth! Just don't expect any such sky-openings during 1991 and 1992."

Dec. 10, 1993: Jomero Releases 'Gloom'

Putting his Inflated Ego on the back burner, Jomero joins Murder Simulators Unlimited and plays a major role in the release of Gloom, a heart-pumping 3D-action game with models consisting of dozens of polygons. "The Gloom engine is so advanced," says Jomero, "I expect to see games still using it in five to ten years." Jomero does not comment on the progress of his own project, Maipiñata.

Oct. 21, 1996: Jomero Quits MSU; Work on 'Maipiñata' Begins Fresh

After finding fame and fortune at Murder Simulators Unlimited, Jomero quits the company that built his reputation and resurrects Inflated Ego's Maipiñata project. "I felt we were too successful at MSU, so I decided to restore the gigantic money pit that would suck investors' funding while offering nothing in return." Maipiñata is planned for a Q3 1997 release date and a retail price of $45.

June 8, 1998: 'Maipiñata': Where Is It?

Months after the announced release date of Maipiñata, Inflated Ego pushes back its release date once again, making the game the most delayed product in the history of the universe. Angry mobs of gamers gather in the village square to construct plans for anti-Jomero vengeance, but quickly lose interest when a hot dog cart strolls by.

May 13, 2000: 'Maipiñata' Is Released

Nearly 25 years in the making, Maipiñata hits the market. The Mexican restaurant sim enters the Top 100 charts at number 78, but falls behind Barbie Hoochie Mama by week two, and falls off the charts entirely by week three. Jomero claims "development was rushed" and promises higher-polygon-count tortilla chips in the sequel.

by Matthew Jolley

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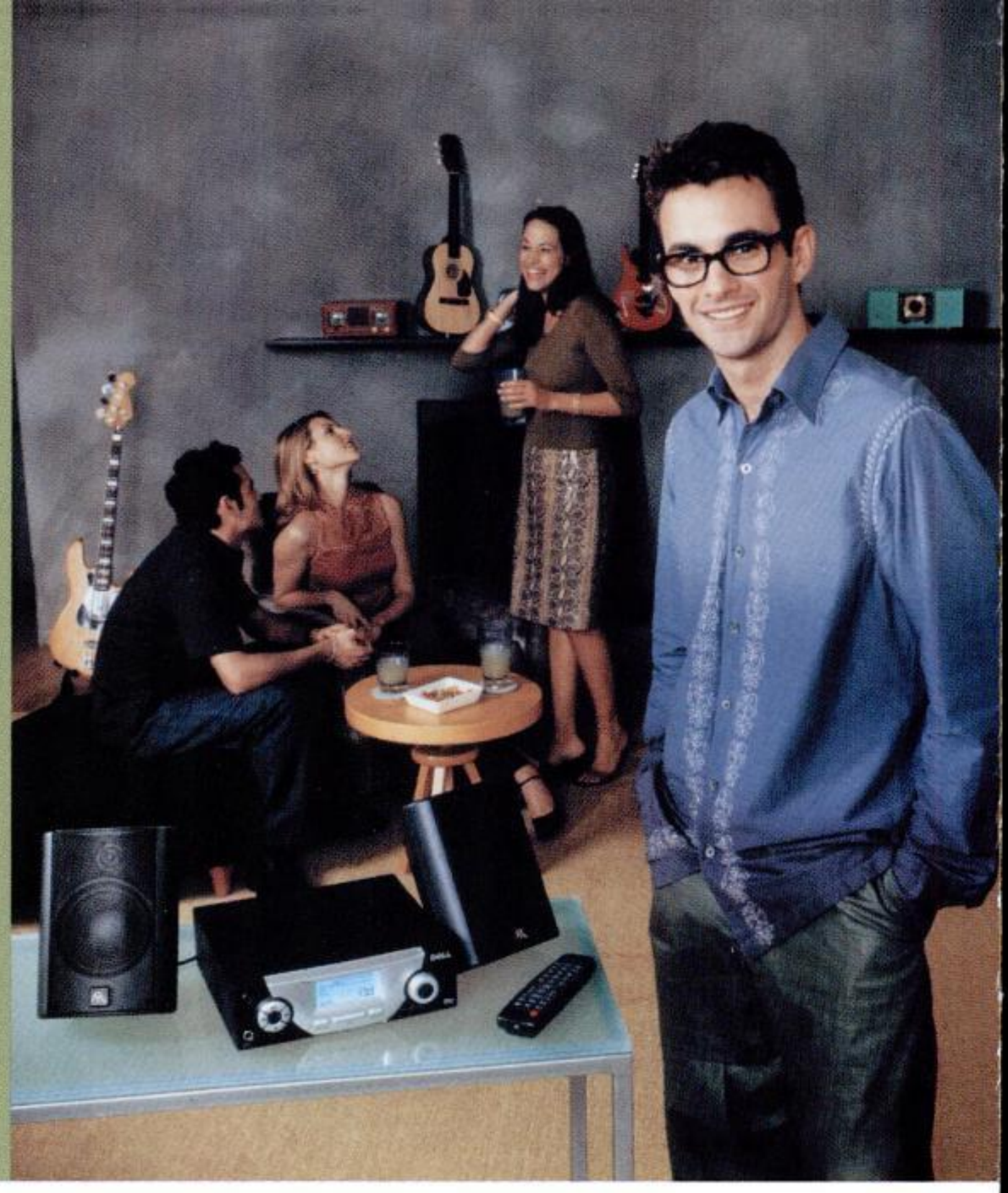

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